

TECHNICAL REPORT

66-1-FD

**ALL PURPOSE MATRICES
for
COMPRESSED FOOD BARS**

by

JACK R. DURST

**The Pillsbury Co.
Minneapolis, Minn.**

Contract No. DA19-129-AMC-2103

January 1966

**UNITED STATES ARMY
NATICK LABORATORIES
Natick Massachusetts 01760**



**Food Division
FD-37**

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FOREWORD

In the design and development of military feeding systems increased emphasis is being given to the reduction of food bulk. Such a reduction becomes a virtual necessity in the development of food packets for the soldier who must carry on his person his entire food supply for indefinite periods when resupply is not feasible. In addition to prescribed nutritional characteristics, the food contained in such packets must combine general acceptability with economy of both weight and bulk. Weight economy can be achieved by use of dehydrated foods, which, fortunately, are microbiologically stable. Compression has long been recognized as a method for reducing the bulk of dry foods. In addition a geometrically regular module resulting from compression provides obvious advantages for packaging and packing.

This project is concerned with the development of food bars which are acceptable for consumption from the compressed state and which can also be rehydrated to yield familiar meal items of even greater acceptability. Conceptually, a variety of casserole items, creamed soups, puddings, and beverages can be supplied as dry bars for direct consumption or for consumption after rehydration. Recognition is given to the fact that many dry foods will require a binder to insure cohesiveness and other desirable physical characteristics after compression. This project is directed to the development and performance of several binders which will insure that a wide variety of dry foods can be compressed into bars suitable for consumption both directly and after rehydration.

The investigation described herein was performed in the Research and Development Laboratories of the Pillsbury Company, 311 Second Street S.E., Minneapolis 14, Minnesota. Dr. Jack Durst served as the Official Investigator. His collaborators were Merlin J. Slettin, John J. Slavics, J. Ringstrom, R. Sundeen, G. Dettlefsen, Jr., J. Blodgett, R. Gauthier, L. Brandberg, and Robert Brunson.

Project Officer for the U.S. Army Natick Laboratories was Dr. Maxwell C. Brockmann of the Animal Products Branch, Food Division. The Alternate Project Officer was Dr. Karl Johnson, Plant Products Branch, Food Division.

FERDINAND P. MEHRLICH, Ph.D.
Director
Food Division

APPROVED:

DALE H. SIELING, Ph.D.
Scientific Director

W. W. VAUGHAN
Brigadier General, USA
Commanding

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ABSTRACT

Edible binders have been developed which impart favorable physical properties including cohesiveness to compressed dry foods representing a broad range of chemical compositions. Further experimental effort yielded binders for compressed foods which are acceptable for consumption from the compressed state and which can also be rehydrated to yield a familiar meal item, such as casseroles, creamed soups, puddings, thin soups and beverages. These binders do not significantly alter the storage stability of the basic food components.

SCOPE OF THE CONTRACT

PHASE I:

1. The objective of this project shall be the development, testing, and demonstration of edible compositions which permit the incorporation of any food having adequate physical, chemical, and microbiological stability into compressed bars which conform to requirements herein specified and which are adaptable to commercial production with existing equipment.

2. Effort shall be confined to two compositions conforming to Compositions A and B below.

	<u>Composition A</u>	<u>Composition B</u>
Kg-Cal per gram, minimum	4.0	6.0
Percent fat, dry basis, maximum	20	50
Percent high quality protein, dry basis	20 to 50	0 to 25
Percent ash, dry basis, maximum	1.5	1.0

Each composition shall conform to current Food and Drug Administration requirements, shall not be the source of objectionable flavors or odors, and shall not adversely alter the flavor or odor of the primary ingredients of the compressed bars.

3. Each composition when used in amounts not to exceed 25 percent by weight with foods such as those listed below and subjected to compression at pressures below 500 p.s.i. shall result in a food bar conforming to special requirements listed in Paragraph 5 herein.

- a. Precooked tapioca
- b. Graham crackers
- c. Dry non-fat milk
- d. Cookies at 5-10% moisture
- e. Pie crust at 10% moisture
- f. Dried peaches at 18% moisture
- g. Peanuts
- h. Freeze dried cooked chicken
- i. Sweet chocolate

- j. Prefried bacon
- k. Dried raisins or dates at 18-20% moisture
- l. Fruit preserves at 20% moisture
- m. Dry fish (cooked)
- n. Precooked freeze dried scrambled eggs
- o. Gouda cheese or equivalent

4. The preparation and components of Composition A and B shall be fully described by the Contractor and submitted in writing. Likewise, all operations in the preparation of each type bar, including pre-compression treatments, shall be adequately described and critical operations shall be supported by data. All process operations shall be recognized as commercially feasible.

5. Compressed bars shall have the following properties:

- a. Rectangular cross section, 1/2 inch thick, weight 2 ounces minimum.
- b. Acceptable odor and taste normal to major ingredients.
- c. Easily sheared by incisors at temperatures between 30 and 100°F. and subsequently chewable without becoming crumbly or difficult to swallow.
- d. Shall not shatter when dropped on a smooth concrete floor from a height of 6 feet and shall remain dimensionally stable within 10 percent when held at 120°F. for 24 hours under a load of 5 pounds per square inch.
- e. Shall not become sticky when held 24 hours at room temperature in the presence of 40% relative humidity.
- f. When packaged in metalized polyethylene polyester pouches, will remain organoleptically acceptable and without significant manifestations of chemical, physical or microbiological deterioration throughout three months storage at 30, 70 and 100°F.

6. The Contractor shall recommend and describe as an engineering design an efficient production process to be submitted in writing, based on currently available equipment and the matrix compositions here demonstrated, for the commercial fabrication of 6000 compressed food bars per hour.

PHASE II:

Commencing with the effective date of modification of the contract, the Contractor shall continue for a period of twelve (12) months thereafter, to perform the additional work to Phase I as follows:

7. Objectives stated in Paragraph 2, Scope, Phase I, and the requirements of Paragraphs 5, 6, and 7 shall be extended to include an additional compression matrix, designated Composition H (See Paragraph 8) and the development of compressed food bars which are acceptable for direct consumption and which disperse and rehydrate in water to yield acceptable casserole-type items (See Paragraph 9), acceptable creamed foods and soups (See Paragraph 10), and acceptable thin soups and beverages (See Paragraph 11). All bars, Composition H, and all components thereof shall meet Food and Drug Administration requirements for food use.

8. In the event Compositions A and B are found unsuitable for bars alternatively used for any of the thin soups or beverages listed in Paragraph 11, Composition H shall be developed as a compression matrix to provide cohesion and other essential properties. Composition H shall contain not less than 3.8 kg-cal per gram (based on human metabolism) at the time of compression. No restriction is placed on the fat, protein, carbohydrate, and ash contents. Composition H shall not be the source of objectionable flavor, odor, or physical properties in either the compressed bar or the rehydrated products therefrom.

9. Compressed bars which rehydrate in hot water to produce the casserole-type items listed below shall be developed from suitable ingredients and may include up to 25 percent by weight of Composition A or B.

- a. Beef stew
- b. Barbecued ground beef
- c. Chili con carne
- d. Ground beef and rice (as for stuffed green peppers)
- e. Shrimp creole

10. Compressed bars which rehydrate in hot water to produce the creamed items listed below shall be developed from suitable ingredients and may contain up to 50 percent by weight of Composition A or B.

- a. Creamed ground beef
- b. Chicken a la king
- c. Cream of mushroom soup
- d. Cream of tomato soup
- e. Creamed lemon or banana pie filling

11. Compressed bars which rehydrate in hot water to produce the soups listed below or in hot or cool water to yield the beverages listed below shall be developed from suitable ingredients which may include up to 50 percent composition A or B or an unlimited amount of Composition H (See Paragraph 8 above).

- a. Beef-barley soup
- b. Shrimp chowder
- c. Coffee with cream and sugar
- d. Tomato juice
- e. Orange juice

INTRODUCTION

While doing research work on food bars in the Pillsbury Research Laboratory, it was found that by use of a Stable Dispersion Process patented by the Pillsbury Company, food bars could be fabricated using the dispersion as a binder matrix. Rather low over-all pressures were required to make the bars. The Pillsbury Company has agreed to the Government's use of this process on the food bars covered in this contract on a royalty free basis.

The stable dispersion or encapsulation process is simply two immiscible systems, a film former in the continuous phase surrounding a liquid or once liquid discontinuous phase. The following are needed to form the stable dispersion: (1) film former, something that is capable of forming a film around something. (2) A liquid which is immiscible in this film former. (3) A plasticizer which actually makes the film former able to form a film. (4) Proper mixing.

For our use in food bars as a universal matrix a stable dispersion is made with known amounts of protein, fat, carbohydrates, minerals, and water. The stable

dispersion is then spray dried and the dry powder is then mixed with the other ingredients of the food bar and placed in a mold and shaped under low pressure into bars 2" x 4" x 1/2" that weigh approximately 2 ounces.

Specifically, for making a stable dispersion binder matrix we take a protein such as sodium caseinate that is hydrated or can be hydrated and limit the amount of the plasticizer to form a film of protein around an oil or a liquid melted normally solid shortening which is immiscible in the protein film. This can be accomplished by simple mixing such as with a Waring Blendor or Hamilton Beach rotary mixer. Once the stable dispersion is formed, it can be diluted with additional water to give whatever viscosity is desired. Other materials such as sugars, vitamins, flavorings, minerals, colors, other proteins, preservatives, etc. may be added to the stable dispersion either before or after the formation of the dispersion depending on the desired results. For example, if one wishes to add a fat soluble flavoring or coloring, they should be added to the liquid fat before the dispersion is formed since the fat will be encapsulated with a film of protein.

An important point in this process is that we add no emulsifiers. Emulsifiers can actually hinder or prevent the formation of a stable dispersion because they can make the water (the plasticizer) more compatible with the oil or melted normally solid fat and thus prevent the stretching of a film around the liquid fat globule. A film around a sphere is a thermodynamically stable structure.

EXPERIMENTAL

I. Preparation of "A" Series of All Purpose Matrices

The "A" Series of matrices was developed to meet the requirements outlined in the Scope of the Contract in a typically evolutionary way. The first matrix, simply designated "A", was formulated to meet the nutritional requirements for this matrix. It compared as follows:

	<u>Contract Requirement:</u>	<u>Experimental</u>
Percent fat, dry basis, maximum	20	20
Percent high quality protein	20-50	23.4
Percent ash, dry basis, maximum	1.5	1.1
Kg-Cal per gram, minimum	4.0	4.9
The complete formula for Matrix A was:		
Lard flakes	20%	
Sodium caseinate	27%	
Sucrose	<u>53%</u>	
Composition A	100%	

This matrix was made by the stable dispersion process and then spray dried as outlined in the Introduction. The result was a white, free-flowing powder whose detailed manufacturing process follows in paragraph A. The food bars were fabricated by procedures outlined in section V.

In taste tests where Composition A was the matrix with graham crackers, vanilla wafers and peanut food bars, the bars were consistently too sweet. This led to the formulation of matrix A₁, which was formulated as follows:

Kex oil (Durkee)	20%
Sodium Caseinate	27%
Lactose	<u>53%</u>
	100%

This matrix was made by the stable dispersion process and then spray dried as outlined in the Introduction. The result was a white, free-flowing powder whose detailed manufacturing process follows in paragraph A. The food bars were fabricated by procedures outlined in section V.

(The change to Kex oil from lard flakes was made with an eye to organoleptic stability during the coming three-month storage study, especially since a 73°F. and 100° F. temperature variable would thus be experienced, and to eliminate the lard flavor and mouth feel.

Since one of the primary considerations in the development of suitable matrices was microbiological stability, it was necessary to spray dry the matrix so that the moisture level was low enough to retard microbiological activity. This was done with the above formula, and with all succeeding formulas described here. The result was always a white, free-flowing powder, whose formula follows:

Corn Starch (Col-Flo 67)	15%
Sucrose	10%
Lactose	28%
Kex Oil	20%
Sodium Caseinate	<u>27%</u>
	100%

This matrix was made by the stable dispersion process and then spray dried as outlined in the Introduction. The result was a white, free-flowing powder whose detailed manufacturing process follows in paragraph A. The food bars were fabricated by procedures outlined in section V.

This formula was somewhat starchy in flavor as the free powder. When used as a matrix in graham crackers, vanilla wafer and peanut food bars, it also contributed a starchy flavor to the complete bar. Therefore, we developed the A₃ matrix whose formula follows:

Corn Starch (Col-Flo 67)	10%
Sucrose	10%
Lactose	18%
Dextrose	15%
Kex Oil (Durkee)	20%
Sodium Caseinate	<u>27%</u>
	100%

The reduced starch level in this matrix solved the flavor problem. Initially, food bars were fabricated from graham crackers, vanilla wafers, peanuts, and bacon together with the A₃ matrix, and in all cases the flavor of the major ingredient was very apparent and unchanged by the presence of the matrix. It was felt then that this matrix would suffice for the general "A" type matrix required in the Scope of the Contract. The complete manufacturing process, together with typical batch size and typical weights is outlined below. It should be noted in this final formula that the fat was changed from Kex oil, which had an A.O.M. stability of 100 hours, to Durkex 500, which has an A.O.M. stability of 500 hours.

A. Matrix A₃

1. Formula

	% Dry	Typical Quantities (lb)
Sodium Caseinate, Edible, Land-O-Lakes	27.00	54.0
Water	-----	216.0
Sucrose, Granulated	10.00	20.0
Dextrose	15.00	30.0
Durkex 500 oil, Durkee	20.00	40.0
Starch	10.00	20.00
Lactose, Foremost Dairies	18.00	36.0
Water (for lactose make-up)	-----	<u>36.0</u>
		452.0 total
		200.0 dry

2. Procedure

- a. Make up 20% Sodium Caseinate solution using Schnellkutter or similar high speed mixer.
- b. Pass to make up tank and raise temperature to 130°F.
- c. Add sucrose and dextrose to Sodium Caseinate solution and mix until dissolved.
- d. Suspend starch in Durkex oil and pass to make up tank, and mix with the Sodium Caseinate solution by passing through an Oakes mixer. Check stability at this

point by floating out a small amount of dispersion in a quantity of 130°F. water. If no "oiling-out" is seen, continue as below. If "oiling-out" does occur, mix for a longer period.

- e. Make up lactose in an equal weight of water, add to make up tank and mix.
- f. Recirculate this completed solution through an Oakes mixer.
- g. Pass to surge tank and spray dry at 2400 psi with an outlet temperature of 170-175°F. and an inlet temperature of 265°F., using a #67 orifice and #17 core

3. Results

A free flowing white powder of the following composition results.

Protein	23.4%
Fat	20.0%
Moisture	3.6%
Ash	1.1%
Carbohydrate	51.1% (by diff.)
Calories	- 4.9 per gram

II. Preparation of "B" Series of All Purpose Matrices

The development of the "B" Series of Matrices also closely followed the requirements outlined in the Scope of the Contract. The first formula, designated "B", compared as follows:

	Contract Requirement	Experimental
Kgm-Cal per gram, minimum	6.0	6.3
Percent fat, dry basis, maximum	50	47.7
Percent high quality protein	0 to 25	16.8
Percent ash, dry basis, maximum	1.0	0.8

The complete formula for matrix B was:

Lard Flakes	47.1%
Sodium Caseinate	19.2%
Sucrose	<u>33.7%</u>
	100.0%

This matrix was made by the stable dispersion process and then spray dried as

outlined in the Introduction. The result was a white, free flowing process following that given in Paragraph A. The food bars were fabricated by procedures outlined in Section V.

When used as a matrix for graham crackers, and vanilla wafer food bars, a "lardy" flavor was detectable. In peanut food bars, the B Matrix contributed a sweet flavor. In order to overcome this, a new formulation, originally called D Matrix, but later changed to B₁ Matrix, was made as follows:

Lard Flakes	47.1%
Sodium Caseinate	19.2%
Dextrin	<u>33.7%</u>
	100.0%

This matrix was made by the stable dispersion process and then spray dried as outlined in the Introduction. The result was a white, free flowing powder whose detailed manufacturing process follows that given in Paragraph A. The food bars were fabricated by procedures outlined in Section V. When this formula was used as a matrix for peanut and graham cracker food bars, the resulting flavor was too "chalky".

Another reformulation of the matrix to overcome the above mentioned complaint resulted in the following B₂ matrix.

Corn Starch (Cal-Flo 67)	10.0%
Lactose	16.7%
Sucrose	7.0%
Kex Oil	47.1%
Sodium Caseinate	<u>19.2%</u>
	100.0%

In graham cracker, vanilla wafer and peanut food bars, this matrix gave good results initially, and it was decided that this formula would be the B type matrix of choice. Again, the Kex oil was changed to Durkex 500 and the complete formula and detailed manufacturing procedure follows:

A. Matrix B₂

1. Formula

	% Dry	Typical Quantities (lb)
Sodium Caseinate, Edible, Land-O-Lakes	19.2	38.4
Water	----	153.6
Sucrose, granulated	7.0	14.0
Durkex 500 Oil, Durkee	47.1	94.2
Starch	10.0	20.0
Lactose, Foremost Dairies	16.7	33.4
Water (for lactose make-up)	----	<u>33.4</u>
		387.0 total
		200.0 dry wt

2. Procedure

- a. Make up 20% Sodium Caseinate solution using Schnellkutter or similar high speed mixer.
- b. Pass to make up tank and raise temperature to 130°F.
- c. Add sucrose to the Sodium Caseinate solution and mix until dissolved.
- d. Suspend starch in the Durkex (temperature 145°F.) oil and pass to make up tank, and mix with the Sodium Caseinate solution by passing through an Oakes mixer. Check stability as noted previously.
- e. Dissolve lactose in an equal weight of water, add to make up tank and mix.
- f. Recirculate the completed solution through an Oakes mixer.
- g. Pass to surge tank and spray dry at 2000 psi with an outlet temperature of 263-270°F. using a #67 orifice and a #17 core.

3. Results

The product was a white, free-flowing powder of the following composition:

Fat	47.7%
Protein	16.8%
Carbohydrate	32.5% (by diff.)
Ash	0.8%

Moisture 2.2%

Calories per gram 6.3

III. Discovery of Matrix "H"

A note on the discovery of a material suitable for use as H matrix as defined in Phase II of the Scope of the Contract is in order here, since it is also used in the formulation of certain food bars. Originally it was intended to manufacture a series of enzyme degraded gelatin preparations in order to test these for cohesion and water dispersability as an indication of their suitability as Matrix H. Our proposed method included the following steps:

1. To samples of gelatin solutions of known concentrations and viscosity, add aliquots of a bromalin solution of known concentration.
2. Incubate samples at 37°C. and withdraw samples at intervals.
3. Heat inactivate the enzymes (90°C. for 10').
4. Centrifuge all samples and determine the viscosity of the supernatant by Brookfield viscometer.
5. Vacuum dry the supernatant and screen samples so obtained for suitability of use as Matrix H.

It was then discovered that Wilson and Co. had a collagen fraction on the market suitable for cosmetic use, and an inquiry by us elicited the information that a similar fraction suitable for food use was also available. This material, "Solu-Pro", can probably be supplied by Wilson at rather lower prices than our proposed enzymatically degraded gelatin. It has proved acceptable, even though a slightly mucilaginous flavor is apparent at high concentrations. The caloric value of this matrix is 3.85 calories per gram, dry basis.

IV. Special Ingredients

In addition to the development of the matrices outlined previously, it became apparent that it was necessary to master certain freeze drying techniques in order to ensure that the requirements of the contract of rapid rehydration be met. In most cases, the commercially available freeze-dried products, particularly the grains (rice,

barley) were not suitable because of grittiness, slow or impossible rehydration without cooking, or poor flavor. The following describes in detail the processing necessary for suitable ingredients as used in the food bars and the compounding of a suitable dry barbecue sauce.

A. Kidney Beans

1. Procedure

- a. Blanch 2 minutes in steam at atmospheric pressure.
- b. Soak in 1% Sodium Bicarbonate solution at room temperature for $1\frac{1}{2}$ hours.
- c. Drain, then soak in 1% Sodium Acid Pyrophosphate at room temperature for $1\frac{1}{2}$ hours.
- d. Drain, then cook in excess of tap water at a slow boil for 25-30 minutes.
- e. Drain and freeze-dry.

B. Rice

1. Procedure

- a. To $8\frac{1}{2}$ lb water add $\frac{1}{2}$ oz salt and bring to a boil.
- b. Add 1 lb long grain par boiled rice and cook at a rolling boil for 25 minutes.
- c. Drain, then rinse in cold water.
- d. Add rice back to 10 lb water per original lb of rice and cook at a rolling boil for 25 minutes.
- e. Drain. Rinse with hot water, then with cold water.
- f. Stir the rice gently to prevent lumping when piling onto freeze drying trays.
- g. Freeze-dry.

C. Barley

1. Procedure

- a. To 8 lb water, add $\frac{1}{2}$ oz salt.
- b. Add 1 lb barley and boil for 1 hour, adding more water if too thick.
- c. Drain and rinse in warm water.

- d. Add back 8 lb water per lb of original barley and cook 30 minutes.
- e. Drain and rinse in warm water.
- f. Add back 8 lb water per pound of original barley and cook 30 minutes longer.
- g. Drain and rinse in warm water, then in cold water.
- h. Stir the barley gently while piling onto freezer trays to avoid lumping.
- i. Freeze-dry.

D. Barbecue Sauce

1. Formula

Onion Powder, soluble	0.29
Celery Seed, ground or whole	0.11
Paprika, ground	0.32
Cayenne Pepper, ground	0.11
Cinnamon, Korintji, ground	0.05
Allspice, ground	0.08
Salt, Flour	5.63
Sugar, granulated	46.30
Tomato Powder, I.D.I.T. S.P.A.*	18.11
Sodium Diacetate	14.50
Smoked Yeast, Florasynth	<u>14.50</u>
	100.00

2. Procedure

- a. Weigh all ingredients into a 1 cubic foot twin cone Patterson-Kelly mixer and mix, using intensifier bar, until homogenous.

E. Pimientos

1. Procedure

Canned whole pimientos were freeze dried without further treatment.

* Available from Tower Instant Foods, Chicago

V. Manufacture of Phase I Food Bars

A. Pregelatinized Tapioca Starch Bars

1. Formula

Pregelatinized Tapioca Starch	75%
A ₃ or B ₂ Matrix	25%
Water/100 g. dry materials	15 ml.

2. Procedure

The starch and the respective matrices were mixed together in a one cubic foot Patterson-Kelly mixer using the blade type intensifier bar. When the mixture was homogenous, the water was added through the intensifier bar. Depth of fill on the Denison hydraulic press was adjusted so that the resulting bars were 1/2" in thickness. About 120 bars were fabricated at 4000 #g.p. (500 psi.) with normal press action and zero dwell time. About 100 bars were packed in aluminized PVC pouches (pouch stock: 0.5 mil mylar, 0.00035" aluminum foil, 3 mil polyvinyl chloride) and 21 were packed under nitrogen in glass jars after being dried 20' at 120°F. Storage of the pouched bars began on August 30, 1963 at 0° F, 35°F, 73°F, and 100°F. The nitrogen packed bars began storage at 0°F, 73°F and 100°F on August 30, 1963 also.

3. Results: The following test results were obtained:

<u>Test</u>	<u>A₃ Matrix</u>	<u>B₂ Matrix</u>
Odor and Flavor	Typical of Tapioca Starch	Typical of Tapioca Starch
Mastication		
a. Shear by Incisors		
(1) 35°F	Fair	Fair
(2) 70°F	Good	Fair
(3) 100°F	Fair	Fair

<u>Test</u>	<u>A₃ Matrix</u>	<u>B₂ Matrix</u>
b. Chew		
(1) 35° F	Fair	Fair
(2) 70° F	Good	Fair
(3) 100° F	Fair	Fair
c. Swallow		
(1) 35° F	Fair	Fair
(2) 70° F	Good	Fair
(3) 100° F	Fair	Fair
Six ft. drop test	One corner broke off on 16th drop	Broke in half on 35th drop
Stickiness (24 hrs) at 40% humidity and room temperature	None	None
Dimensional Stability (24 hrs. at 120° F and 5 psi.)		
a. Before	1/2" x 1 31/32" x 3 15/16"	1/2" x 1 15/16" x 3 7/8"
b. After	15/32" x 1 15/16" x 3 7/8"	15/32" x 1 15/16" x 3 25/32"
c. Net Change	-1/32" -1/32" 1/16"	-1/32" 0 -3/32"
d. Percent change	-6.25 -1.58 -1.58	-6.25 0.00 -2.42
Moisture (16 hr vacuum over)		
a. Nitrogen pack	11.44	12.15
b. Pouch pack	12.54	13.90
Bacteriology	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
a. SPC	2700	1200
b. Coliforms	< 10	> 5
c. Yeasts and Molds	20	< 10
d. Staphylococcus	neg.	neg.

Storage StudyA₃ MatrixB₂ Matrix2 Week - 35° F.Nitrogen PackPouch PackNitrogen PackPouch Pack

Organoleptic

shear	-	very difficult	-	very difficult
Odor	-	typical	-	typical
flavor	-	typical	-	typical

73° F.

Bacteriology

SPC	-	550	-	220
Coliforms	-	< 10	-	< 10
Yeast & Molds	-	< 10	-	< 10
Staphylococcus	-	neg.	-	neg.
Moisture	-	11.32	-	14.20

Organoleptic

shear	difficult	difficult	difficult	difficult
Odor	typical	typical	typical	typical
Flavor	typical	typical	typical	typical

100° F.

Bacteriology

SPC	2000	300	300	330
Coliforms	< 10	< 10	< 10	< 10
Yeasts & Molds	15	20	15	15
Moisture	-	10.37	-	13.49

Organoleptic

Shear	very difficult	very difficult	very difficult	very difficult
Odor	typical	typical	typical	typical
Flavor	typical	rubber like	typical	rubber like

Storage Study cont.

A3 Matrix	
Nitrogen Pack	Pouch Pack

B2 Matrix	
Nitrogen Pack	Pouch Pack

4 Week - 35° F.

Organoleptic

shear	-	difficult	-	difficult
Odor	-	typical	-	typical
Flavor	-	typical	-	typical

73° F.

Organoleptic

Shear	difficult	very difficult	difficult	impossible
Odor	typical	typical	typical	typical
Flavor	typical	typical	typical	typical

100° F.

Organoleptic

Shear	difficult	difficult	impossible	impossible
Odor	typical	typical	typical	typical
Flavor	typical	typical	typical	typical

8 Week - 35° F.

Organoleptic

Shear	-	very difficult	-	very difficult
Odor	-	typical	-	typical
Flavor	-	typical	-	typical

73° F.

Organoleptic

Shear	impossible	very difficult	impossible	impossible
Odor	typical	typical	typical	typical
Flavor	typical	typical	typical	typical

100° F.

Organoleptic

Shear	difficult	very difficult	impossible	impossible
Odor	typical	typical	typical	typical
Flavor	typical	typical	typical	typical

13 Week 35° F.

Organoleptic

Shear	-	difficult	-	difficult
Odor	-	typical	-	typical
Flavor	-	typical	-	typical

73° F.

Organoleptic

Shear	difficult	very difficult	difficult	impossible
Odor	typical	typical	typical	typical
Flavor	typical	typical	typical	typical

100° F.

Organoleptic

Shear	very difficult	very difficult	very difficult	impossible
Odor	typical	typical	typical	typical
Flavor	typical	typical	typical	typical

26 Week 35° F.

Organoleptic

Shear	-	very difficult	-	very difficult
Odor	-	typical	-	typical
Flavor	-	typical	-	typical

73° F.

Organoleptic

Shear	difficult	impossible	difficult	impossible
Odor	typical	typical	typical	typical
Flavor	typical	typical	typical	typical

100° F.

Organoleptic

Shear	impossible	impossible	impossible	impossible
Odor	typical	typical	typical	typical
Flavor	typical	typical	typical	typical

<u>52 Week 72°F</u>	<u>A₃ Matrix</u>		<u>B₂ Matrix</u>	
	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
Moisture		11.98		13.29
Bacteriology				
SPC	1650	150	170	190
Coliforms	< 10	< 10	< 10	< 10
Yeasts & Molds	< 10	< 10	< 10	< 10
Staphlococcus	neg	neg	neg	neg
Salmonella	neg	neg	neg	neg

100°F.

Moisture		12.11		13.29
Bacteriology				
SPC	160	190	180	140
Coliforms	< 10	< 10	< 10	< 10
Yeasts & Molds	< 10	< 10	< 10	< 10
Staphlococcus	neg	neg	neg	neg
Salmonella	neg	neg	neg	neg

B. Graham Cracker Bars

1. Formula

Graham crackers 75%

A₃ and B₂ Matrix 25%

Water/100 gm. dry material 5 ml.

2. Procedure

The graham crackers were placed in a 12 qt. bowl and broken up on speed #2 of the A-200 Hobart mixer until the largest fragment remaining was 1/2" in its largest dimension. The respective matrices were added and mixing was continued until homogenous. Water was then added by separatory funnel while mixing continued. Depth of fill was adjusted on the Denison hydraulic press so that resulting bars were 1/2" thick. About 120 bars were fabricated at 6000 #g.p. (750 psi.) and zero dwell time with normal action of the press (both upper and lower rams activated). The bars were finished by drying for 20' at 120°F. About 100 were sealed into aluminized mylar pouches (pouch stock was

0.5 mil mylar, 0.00035" aluminum foil and 3 mil polyvinyl chloride.) Twenty-one bars were sealed under nitrogen in glass jars. Storage at 100°F, 73°F, and 0°F was begun on August 30, 1963 for the pouched bars. The nitrogen packed bars began storage on August 23, 1963 at 100°F, 73°F, and 0°F.

3. Results

The following test results were obtained initially.

<u>Test</u>	<u>A₃ Matrix</u>	<u>B₂ Matrix</u>
Odor and Flavor	typical of graham crackers	typical of graham crackers
Mastication		
a. Shear by Incisors		
(1) 35°F	good	good
(2) 70°F	good	good
(3) 100°F	good	good
b. Chew		
(1) 35°F	good	good
(2) 70°F	good	good
(3) 100°F	good	good
c. Swallow		
(1) 35°F	good	good
(2) 70°F	good	good
(3) 100°F	good	good
Six foot Drop Test	Broke into 2 pcs. on 4th drop	Broke into 2 pcs. on 6th drop
Stickiness (24 hrs. at 40% humidity and room temp.)	none	none
Dimensional Stability (24 hrs at 120°F and 5 psi)		
a. Before	17/32"x2 1/32"x4 1/32"	15/32"x2 1/32"x4 1/32"
b. After	1/2"x2 1/32"x4 1/32"	7/16"x2 1/32"x4 1/32"
c. Net Change	-1/32 0 0	-1/32" 0 0
d. Percent change	-5.88 0.00 0.00	-6.66 0.00 0.00
Moisture % (16 hr. vacuum oven)		
a. Nitrogen pack	7.66	6.49
b. pouch pack	8.38	6.99

	<u>A₃ Matrix</u>		<u>B₂ Matrix</u>	
	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
Bacteriology				
SPC	1040	180	290	200
Coliforms	< 10	< 10	< 10	< 10
Yeasts and Molds	< 10	< 10	< 10	< 10
Staphylococcus	neg.	neg.	neg.	neg.
Storage Study				
<u>2 Weeks</u>				
<u>35° F.</u>				
Organoleptic				
Shear	-	good	-	good
Odor	-	typical	-	typical
Flavor	-	typical	-	typical
<u>73° F.</u>				
Bacteriology				
SPC	-	730	-	550
Coliforms	-	< 10	-	< 5
Yeasts & Molds	-	< 10	-	< 10
Staphlococcus	-	neg.	-	neg.
Moisture %	-	7.96	-	8.48
Organoleptic				
Shear	good	good	good	good
Odor	typical	typical	typical	typical
Flavor	typical	typical	typical	typical
<u>100° F</u>				
Bacteriology				
SPC	700	240	400	200
Coliforms	< 10	< 10	< 10	< 10
Yeasts & Molds	< 10	< 10	5	10

<u>2 Weeks</u>	<u>A3 Matrix</u>		<u>B2 Matrix</u>	
	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
<u>100°F</u>				
Moisture	-	4.80	-	3.18
Organoleptic				
Shear	good	good	good	good
Odor	typical	typical	typical	typical
Flavor	typical	typical	typical	typical
<u>4 Weeks</u>				
<u>35°F</u>				
Organoleptic				
Shear	-	good	-	good
Odor	-	typical	-	typical
Flavor	-	typical	-	typical
<u>73°F</u>				
Organoleptic				
Shear	good	good	good	good
Odor	typical	typical	typical	typical
Flavor	typical	typical	typical	typical
<u>100°F</u>				
Organoleptic				
Shear	good	good	good	good
Odor	typical	typical	typical	typical
Flavor	typical	typical	typical	typical
<u>8 Weeks</u>				
<u>35°F</u>				
Organoleptic				
Shear	-	good	-	good
Odor	-	typical	-	typical
Flavor	-	typical	-	typical

	<u>A₃ Matrix</u>		<u>B₄ Matrix</u>	
<u>73°F</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
Organoleptic				
Shear	good	good	good	good
Odor	typical	typical	typical	typical
Flavor	typical	typical	typical	typical
<u>100°F</u>				
Organoleptic				
Shear	good	good	good	good
Odor	typical	typical	typical	typical
Flavor	typical	typical	typical	stale
<u>13 Weeks</u>				
<u>35°F.</u>				
Organoleptic				
Shear	-	good	-	good
Odor	-	typical	-	typical
Flavor	-	typical	-	typical
<u>73°F</u>				
Organoleptic				
Shear	good	good	good	good
Odor	typical	typical	typical	typical
Flavor	typical	typical	typical	typical
<u>100°F</u>				
Organoleptic				
Shear	good	good	good	good
Odor	typical	typical	typical	typical
Flavor	typical	typical	typical	typical
<u>26 Weeks</u>				
<u>35°F</u>				
Organoleptic				
Shear	-	good	-	good
Odor	-	typical	-	typical
Flavor	-	typical	-	typical
<u>73°F</u>				
Organoleptic				
Shear	good	good	good	good
Odor	typical	typical	typical	typical
Flavor	typical	typical	typical	typical
<u>100°F</u>				
Organoleptic				
Shear	good	good	good	good
Odor	typical	typical	typical	typical
Flavor	typical	typical	typical	typical

<u>52 weeks</u> <u>73°F</u>	<u>A₃ Matrix</u>		<u>B₂ Matrix</u>	
	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
Moisture %		6.98		5.87
Bacteriology				
SPC	640	500	200	10
Coliforms	<10	<10	<10	<10
Yeasts & Molds	<10	<10	<10	<10
Staphylococcus	Negative	Negative	Negative	Negative
Salmonella	Negative	Negative	Negative	Negative

100°F

Moisture %		8.24		8.10
Bacteriology				
SPC	10	50	20	60
Coliforms	<10	<10	<10	<10
Yeasts & Molds	<10	<10	<10	<10
Staphylococcus	Negative	Negative	Negative	Negative
Salmonella	Negative	Negative	Negative	Negative

C. Non-Fat Dry Milk (Maple Island-Instant) Bar

1. Formula

Non-fat Dry Milk (Maple Island-Instant)	75%
A ₃ or B ₂ Matrix	25%
Water/100 gm Dry Material	5 ml

2. Procedure

The dry milk solids together with the respective matrices were mixed together in a 12 qt. bowl on the A-200 Hobart mixer at speed #2. The water was added dropwise while mixing by means of a separatory funnel. Depth of fill was adjusted on the Denison hydraulic press so that resulting bars were 1/2" in thickness. Bars were pressed at 6000# gauge pressure (750 psi) with zero dwell time and normal action of both rams (simultaneous pressing of both upper and lower rams). The resulting 120 bars were dried in a hot air oven for 20 minutes at 120°F. Twenty one were packed in a glass

jars under a nitrogen atmosphere and the remainder was sealed into aluminized mylar pouches. Pouch stock is 0.5 mil mylar 0.00035" aluminum foil, and 3 mil polyvinyl chloride. Storage of the pouched bars was begun August 30, 1963 at 100°F, 73°F, 35°F, and 0°F. The nitrogen packed bars were placed in storage at 100°F, 73°F, and 0°F on August 30, 1963 also.

3. Results:

Initially the following test results were obtained.

<u>Test</u>	<u>A₃ Matrix</u>	<u>B₂ Matrix</u>
Odor and Flavor	Typical of non-fat dry milk	Typical of non-fat dry milk
<u>Mastication</u>		
a. Shear by incisors		
(1) 35°F	Good	Good
(2) 70°F	Good	Good
(3) 100°F	Good	Good
b. Chew		
(1) 35°F	Good	Good
(2) 70°F	Good	Good
(3) 100°F	Good	Good
c. Swallow		
(1) 35°F	Good	Good
(2) 70°F	Good	Good
(3) 100°F	Good	Good
<u>6-Foot Drop Test</u>	Broke into 3 pcs. each approx. 1/3 of bar	Broke into 3 pcs each approx. 1/3 of bar
Stickiness (24 hrs. at 40% humidity and room temperature)	None	None
Dimensional Stability (24 hrs. @120°F. and 5 psi.)		
Before	1/2" x 2-1/32" x 4-1/32"	17/32" x 2-1/32" x 4-1/32"
After	1/2" x 2" x 4"	17/32" x 2-1/32" x 4"

		<u>A₃ Matrix</u>			<u>B₂ Matrix</u>	
Net Change	0	-1/32"	-1/32"	0	0	-1.32"
Percent Change	0.00	-1.53	-0.77	0.00	0.00	-0.77

Moisture (16 hr.
vacuum oven)

Nitrogen pack	7.77	6.49
Pouch pack	7.38	7.00

Test

Bacteriology	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
SPC	1590	1200	2660	1260
Coliforms	10	5	10	5
Mold & Yeast	40	30	80	30
Staphylococci	Neg.	Neg.	Neg.	Neg.

Storage Study

2 Weeks

35°F

Organoleptic

Shear	-	Difficult	-	Difficult
Odor	-	Typical	-	Typical
Flavor	-	Typical	-	Typical

73°F

Bacteriology

SPC	2330	2020
Coliforms	10	10
Yeasts & Molds	10	10
Staphylococcus	Neg.	Neg.

Moisture	6.74	6.96
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Organoleptic

Shear	Very difficult	Very difficult
Odor	Typical	Typical
Flavor	Typical	Typical

<u>100° F</u>	<u>A₃ Matrix</u>		<u>B₂ Matrix</u>	
Bacteriology	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
SPC	2420	740	2000	770
Coliforms	10	10	10	10
Yeasts & Molds	120	20	110	20
Moisture	6.34		6.50	
Organoleptic				
Shear	Very difficult	Very difficult	Very difficult	Very difficult
Odor	Typical	Typical	Typical	Typical
Flavor	Typical	Typical	Typical	Typical
<u>4 Weeks</u>				
<u>35° F</u>				
Organoleptic				
Shear	-	Difficult	-	Difficult
Odor	-	Typical	-	Typical
Flavor	-	Typical	-	Typical
<u>73° F</u>				
Organoleptic				
Shear	Difficult	Difficult	Difficult	Good
Odor	Typical	Typical	Typical	Typical
Flavor	Typical	Typical	Typical	Typical
<u>100° F</u>				
Organoleptic				
Shear	Difficult	Difficult	Difficult	Difficult
Odor	Typical	Typical	Typical	Typical
Flavor	Typical	Typical	Typical	Typical
<u>8 Weeks</u>				
<u>35° F</u>				

	<u>A₃ Matrix</u>		<u>B₂ Matrix</u>	
	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
Organoleptic				
Shear	-	Difficult	-	Difficult
Odor	-	Typical	-	Typical
Flavor	-	Typical	-	Typical
<u>73°F</u>				
Organoleptic				
Shear	Difficult	Difficult	Difficult	Difficult
Odor	Sl. burned	Typical	Typical	Typical
Flavor	Sl. burned	Typical	Typical	Typical
<u>100°F</u>				
Organoleptic				
Shear	Difficult	Difficult	Difficult	Difficult
Odor	Typical	Typical	Typical	Typical
Flavor	Typical	Typical	Typical	Typical
<u>13 Week</u>				
<u>35°F</u>				
Organoleptic				
Shear	-	Difficult	-	Difficult
Odor	-	Typical	-	Typical
Flavor	-	Typical	-	Typical
<u>73°F</u>				
Organoleptic				
Shear	Difficult	Difficult	Difficult	Difficult
Odor	Typical	Typical	Typical	Typical
Flavor	Typical	Typical	Typical	Typical
<u>100°F</u>				
Organoleptic				
Shear	Difficult	Difficult	Difficult	Difficult
Odor	Typical	Typical	Typical	Typical
Flavor	Typical	Typical	Typical	Typical

26 WeeksA₃ MatrixB₂ Matrix35°F

Organoleptic

Nitrogen PackPouch PackNitrogen PackPouch Pack

Shear

-

Difficult

-

Difficult

Odor

-

Typical

-

Typical

Flavor

-

Typical

-

Typical

73°F

Organoleptic

Shear

Difficult

Difficult

Difficult

Difficult

Odor

Typical

Typical

Typical

Typical

Flavor

Typical

Typical

Typical

Typical

100°F

Organoleptic

Shear

Difficult

Impossible

Difficult

Impossible

Odor

Sl. burned milk

Burned milk

Sl. burned milk

Burned milk

Flavor

Sl. burned milk

Burned milk

Sl. burned milk

Burned milk

52 Weeks73°F

Moisture

6.85

7.70

Bacteriology

SPC

1380

2320

Coliforms

<10

15

Yeast & Molds

110

40

Staphylococcus

Neg.

Neg.

Salmonella

Neg.

Neg.

100°F

Bacteriology

SPC

310

110

105

80

Coliforms

<10

<10

<10

<10

Yeasts & Molds

<10

<10

<10

<10

100°F (continued)A₃ MatrixB₂ Matrix

<u>Bacteriology</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
Staphylococcus	Negative	Negative	Negative	Negative
Salmonella	Negative	Negative	Negative	Negative

D. Sugar Cookie Bar

1. Formula

Sugar Cookie 75%

A₃ or B₂ Matrix 25%

Water/100 gm Dry Material 5 ml

2. Procedure

Sugar cookies were weighed into a 12 qt. Hobart mixing bowl and broken up on speed #1 on the Hobart A-200 mixer until the largest fragments remaining were approximately 3/4" in the longest dimension. The respective matrices were then added and the whole mixed until homogenous. Water was then added by separatory funnel while mixing continued. Depth of fill on the Derison press was adjusted so that resulting bars were 1/2" thick. Bars were pressed at 2000 #g.p. (250 psi) and a dwell time of "30%-10 sec." Stratification and cracking of the bar in its horizontal plane was avoided by inactivating the lower ram and attaining pressure by use of the upper ram only. About 120 bars were manufactured, and these were dried in a forced draught oven at 120°F. Twenty one were packed in glass jars under a nitrogen atmosphere, and the remainder was sealed into alumized mylar pouches. Pouch stock is 0.5 mil mylar, 0.00035" aluminum foil, and 3 mil polyvinyl chloride. Storage of the pouched bars was begun August 30, 1963 at 100°F, 73°F, 35°F, and 0°F. The nitrogen packed bars were placed in storage at 100°F, 73°F, and 0°F on August 30, 1963 also.

3. Results

Initially the following test results were obtained.

<u>Test</u>	<u>A₃ Matrix</u>	<u>B₂ Matrix</u>
Odor & Flavor	Typical of Sugar Cookie	Typical of Sugar Cookie

Mastication

a. Shear by Incisors

(1) 35°F	Good	Good
(2) 70°F	Good	Good
(3) 100°F	Good	Good

b. Chew

(1) 35°F	Good	Good
(2) 70°F	Good	Good
(3) 100°F	Good	Good

c. Swallow

(1) 35°F	Good	Good
(2) 70°F	Good	Good
(3) 100°F	Good	Good

6 Foot Drop Test

Broke into 3 pcs on
2nd dropBroke into quarters on
1st dropStickiness (24 hrs.
@ 40% humidity and
room temp.)

None

None

Dimensional Stability
(24 hrs. @ 120°F and
5 psi)

Before	1/2" x 2" x 4-1/32"			1/2" x 2-1/32" x 4-1/32"		
After	1/2" x 2" x 4-1/32"			1/2" x 2-1/32" x 4-1/32"		
Net Change	0	0	0	0	0	0
Percent Change	0.00	0.00	0.00	0.00	0.00	0.00

Moisture % (16 hr.
vacuum oven)

Nitrogen Pack	6.66	7.61
Pouch Pack	7.34	8.11

Bacteriology

	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
SPC	770	1260	490	28
Coliforms	<10	>5	<10	<10

Bacteriology (cont'd)	<u>A₃ Matrix</u>		<u>B₂ Matrix</u>	
	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
Molds & Yeasts	<10	30	<10	≤10
Staphylococci	Neg.	Neg.	Neg.	Neg.

Storage Study

2 week - 35°F

Organoleptic	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
Shear	-	Good	-	Good
Odor	-	Typical	-	Typical
Flavor	-	Typical	-	Typical

73°F

Bacteriology

SPC	990	370
Coliforms	>10	<10
Yeasts & Molds	<10	<10
Staphylococcus	Neg.	Neg.

Moisture %	7.85	7.98
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Organoleptic	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
Shear	Good	Good	Good	Good
Odor	Typical	Typical	Typical	Typical
Flavor	Typical	Typical	Typical	Typical

100°F

Bacteriology	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
SPC	770	280	260	200
Coliforms	<10	<10	<10	<10
Yeasts & Molds	<10	<10	5	<10

Moisture %	6.72	8.16
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Organoleptic	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
Shear	Good	Good	Good	Good
Odor	Typical	Typical	Typical	Typical

A3 MatrixB2 Matrix

Organoleptic (cont'd)	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
Flavor	Typical	Typical, but bitter after-taste	Typical	Typical, but rancid fat after taste

4 Week35°F

Organoleptic	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
Shear	-	Good	-	Good
Odor	-	Typical	-	Typical
Flavor	-	Typical	-	Typical

73°F

Organoleptic	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
Shear	Good	Good	Good	Good
Odor	Typical	Typical	Typical	Typical
Flavor	Typical	Typical	Typical	Typical

100°F

Organoleptic	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
Shear	Good	Good	Good	Good
Odor	Typical	Typical	Typical	Typical
Flavor	Typical	Typical	Typical	Typical

8 week - 35°F

Organoleptic	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
Shear	-	Good	-	Good
Odor	-	Typical	-	Typical
Flavor	-	Typical	-	Typical

73°F

Organoleptic				
Shear	Good	Good	Good	Good
Odor	Typical	Typical	Typical	Typical
Flavor	Typical	Typical	Typical	Typical

100°F

A₃ Matrix

B₂ Matrix

Organoleptic	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
Shear	Good	Good	Good	Good
Odor	Typical	Typical	Typical	Typical
Flavor	Typical; bitter after taste	Typical	Typical; bitter after taste	Typical

13 Weeks

35°F

Organoleptic				
Shear	-	Good	-	Good
Odor	-	Typical	-	Typical
Flavor	-	Typical	-	Typical

73°F

Organoleptic				
Shear	Good	Good	Good	Good
Odor	Typical	Typical	Typical	Typical
Flavor	Typical	Typical	Typical	Typical

100°F

Organoleptic				
Shear	Different	Good	Different	Good
Odor	Typical	Typical	Typical	Typical
Flavor	Typical	Typical	Typical	Typical

26 Weeks

35°F

Organoleptic				
Shear	-	Good	-	Good
Odor	-	Typical	-	Typical
Flavor	-	Typical	-	Typical

73°F

Organoleptic				
Shear	Good	Good	Good	Good

Organoleptic (cont'd)	<u>A3 Matrix</u>		<u>B2 Matrix</u>	
	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
Odor	Typical	Typical	Typical	Typical
Flavor	Typical	Typical	Typical	Typical

100°F

Organoleptic

Shear	Good	Good	Good	Good
Odor	Typical	Typical	Typical	Typical
Flavor	Typical	Typical	Typical	Typical

52 week

72°F

Moisture %	7.81	7.01
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Bacteriology

SPC	510	210	320	365
Coliforms	<10	<10	<10	<10
Yeasts & Molds	<10	<10	<10	<10
Staphylococcus	Neg.	Neg.	Neg.	Neg.
Salmonella	Neg.	Neg.	Neg.	Neg.

100°F

Moisture %	7.99	7.41
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Bacteriology

SPC	530	70	630	50
Coliforms	<10	<10	<10	<10
Yeasts & Molds	<10	<10	<10	<10
Staphylococcus	Neg.	Neg.	Neg.	Neg.
Salmonella	Neg.	Neg.	Neg.	Neg.

E. Pie Crust Bars

1. Formula

Pie Crust (baked)	75%
A ₃ or B ₂ Matrix	25%
Water/100 gm dry materials	5 ml.

2. Procedure

The pie crust was weighed into a 12 qt. bowl and broken up on the Hobart A-200 mixer on speed #2. The matrix was added and the whole mixed until homogenous. Water was added by separatory funnel while mixing continued. Depth of fill on the Denison hydraulic press was adjusted so that resulting bars were 1/2" thick. Bars were then pressed at 4000 # g.p. (500 psi.) and a dwell time of "15% -10 sec." and normal action of both upper and lower rams. The resulting bars were dried for 20' at 120°F. Of the 120 bars manufactured, about 100 were packed in aluminized mylar pouches. (Pouch stock: 0.5 mil mylar, 0.00035" aluminum foil and 3 mil polyvinyl chloride). Twenty-one were sealed under nitrogen in glass jars. Storage of the pouched bars was begun August 30, 1963 at 100°F, 73°F, and 0°F. Nitrogen packed jars were placed in storage on August 30, 1963 at 100°F, 73°F, and 0°F.

3. Results : The following test results were obtained initially:

Test	<u>A₃ Matrix</u>	<u>B₂ Matrix</u>
Odor and Flavor	Typical of pie crust	Typical of pie crust
Mastication		
a. Shear by Incisors		
(1) 35°F	Good	Good
(2) 70°F	Good	Good
(3) 100°F	Good	Good
b. Chew		
(1) 35°F	Good	Good
(2) 70°F	Good	Good
(3) 100°F	Good	Good

<u>Test</u>	<u>A₃ Matrix</u>			<u>B₂ Matrix</u>		
c. Swallow						
(1) 35°F	Good			Good		
(2) 70°F	Good			Good		
(3) 100°F	Good			Good		
6 Foot Drop Test	Broke into 3 pcs. on 4th drop			Broke into 3 pcs. on 1st drop		
Bacteriology	<u>Nitrogen Pack</u>		<u>Pouch Pack</u>	<u>Nitrogen Pack</u>		<u>Pouch Pack</u>
SPC	250		420	350		460
Coliforms	<10		<10	>10		<10
Molds & Yeasts	20		<10	10		>5
Staphylococci	neg.		neg.	neg.		neg.
Stickiness (24 hrs at 40% humidity and room temp.)	none			None		
Dimensional Stability (24 hrs. at 120°F and 5 psi)						
Before	1/2"x2 1/32"x4 1/16"			17/32"x2 1/32"x4 1/16"		
After	15/32"x2 1/32"x4 1/16"			1/2"x2 1/32"x4 1/32"		
Net Change	-1/32"	0	0	-1/32"	0	-1/32"
Percent change	-5.00	0.00	0.00	-5.88	0.00	-0.77
Moisture						
Nitrogen pack	10.56			7.86		
Pouch pack	10.24			7.88		
Storage Study						
<u>2 Weeks</u>						
<u>35°F</u>						
Organoleptic						
Shear	good			good		
Odor	Typical			Typical		
Flavor	Typical			Typical		

2 Weeks

	A ₃ Matrix		B ₂ Matrix	
	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
<u>73°F</u>				
Bacteriology				
SPC		520		360
Coliforms		<10		<10
Yeasts & Molds		<10		<10
Staphylococcus		neg.		neg.
Moisture		9.97		8.07
Organoleptic				
Shear	good	good	good	good
Odor	sl. rancid fat	typical	typical	typical
Flavor	typical/bitter after taste	typical/bitter after taste	typical/bitter after taste	typical/bitter after taste

100°F

Bacteriology				
SPC	1120	420	400	382
Coliforms	<10	<10	<10	<10
Yeasts & molds	20	<10	20	<10
Moisture		10.69		7.93
Organoleptic				
Shear	Good	Good	Good	Good
Odor	Rancid Fat	Rancid Fat	Rancid Fat	Rancid Fat
Flavor	" "	" "	" "	" "

4 Weeks

35°F

Organoleptic				
Shear		Good		Good
Odor		typical		typical
Flavor		Typical		typical

Storage Study cont'd

4 Weeks73°F

	<u>A₃ Matrix</u>		<u>B₂ Matrix</u>	
	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>

Organoleptic

Shear	good	good	good	good
Odor	sl. rancid fat	sour rancid fat	typical	rancid, bitter
Flavor	sl. rancid fat	sour rancid fat	typical	rancid, bitter

100°F

Organoleptic

Shear	good	good	good	good
Odor	sl. rancid fat	rancid fat	typical	rancid fat
Flavor	sl. rancid fat	rancid/bitter	typical	bitter

8 weeks35°F

Organoleptic

Shear		Good		Good
Odor		sl. rancid fat		sl. rancid fat
Flavor		sl. rancid fat		sl. rancid fat

73°F

Organoleptic

Shear	Good	Good	Good	Good
Odor	rancid	rancid	typical	sl. rancid
Flavor	rancid/bitter after taste	rancid	sl. rancid	sl. rancid

100°F

Organoleptic

Shear	Good	Good	Good	Good
Odor	rancid fat	rancid fat	rancid fat	rancid fat
Flavor	bitter	rancid fat	rancid fat	bitter

Storage Study cont'd

	<u>A₃ Matrix</u>		<u>B₂ Matrix</u>	
	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
<u>13 Week</u>				
<u>35°F</u>				
Organoleptic				
Shear		good		good
Odor		typical		typical
Flavor		typical		typical
<u>75°F</u>				
Organoleptic				
Shear	good	good	good	good
Odor	typical	sl rancid fat	typical	sl. rancid fat
Flavor	typical	sl. bitter	typical	sl. bitter
<u>100°F.</u>				
Organoleptic				
Shear	good	good	good	good
Odor	typical	typical	typical	rancid
Flavor	bitter	sl. bitter	bitter	bitter
<u>26 Weeks</u>				
<u>35°F</u>				
Organoleptic				
Shear		good		good
Odor		typical		typical
Flavor		typical		typical
<u>73°F</u>				
Organoleptic				
Shear	moldy	good	good	good
Odor	Not tested	typical	typical	typical
Flavor	Not tested	typical	typical	typical

Storage Study cont'd

<u>26 Weeks</u> <u>100°F</u>	<u>A₃ Matrix</u>		<u>B₂ Matrix</u>	
	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
Organoleptic				
Shear	moldy	good	good	good
Odor	not tested	typical	typical	typical
Flavor	not tested	bitter	bitter	bitter

52 Weeks

72°F

Moisture		10.86		7.55
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Bacteriology

SPC	80	320	100	110
Coliforms	<10	<10	<10	<10
Yeasts & Molds	10	<10	60	<10
Staphylococcus	neg	neg	neg	neg
Salmonella	neg	neg	neg	neg

100°F

Moisture		11.03		8.05
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Bacteriology

SPC	90	50	40	40
Coliforms	<10	<10	<10	<10
Yeasts & Molds	<10	<10	<10	<10
Staphylococcus	neg	neg	neg	neg
Salmonella	neg	neg	neg	neg

F. Peach Bars

1. Formula

Peaches, dried	75%
A ₃ or B ₂ Matrix	25%
Water/100 gm. dry materials	4 ml.

2. Procedure

Peach halves were chopped using a 1 gal. Waring blender canister. Water was added by separatory funnel to the chopped peach halves in a 12 qt. Hobart mixer bowl with mixing on speed #2. The matrix was next added and mixing was continued until the peach pieces were uniformly coated with matrix. Depth of fill on the Danison hydraulic press was adjusted so that resulting bars were 1/2" thickness. About 120 bars were fabricated at "2500 #g.p." (312.5 psi) and a dwell time of "25%-10 sec." with the lower ram of the press stationary thus duplicating the action of the Carver laboratory press. Bars were dried for 30 minutes at 120°F and about 100 were sealed in aluminized PVC pouches (pouch stock: 0.5 mylar 0.00035" aluminum foil and 3 mil polyvinyl chloride). Twenty-one were sealed under nitrogen in glass jars. The storage of pouched bars was begun on August 30, 1963 at 0°F, 35°F, 73°F, and 100°F. Storage of nitrogen packed bars was begun on August 30, 1963 also, but at 0°F, 73°F and 100°F.

3. Results: Initially the following test results were obtained.

<u>Test</u>	<u>A₃ Matrix</u>	<u>B₂ Matrix</u>
Odor and Flavor	Typical of dried peaches	Typical of dried peaches
Mastication		
a. Shear by Incisors		
(1) 35°F	good	good
(2) 70°F	good	good
(3) 100°F	good	good
b. Chew		
(1) 35°F	good	good
(2) 70°F	good	good
(3) 100°F	good	good
c. Swallow		
(1) 35°F	good	good
(2) 70°F	good	good
(3) 100°F	good	good

Dimensional Stability (24 hrs. at 120°F and 5 psi)	<u>A₃ Matrix</u>			<u>B₂ Matrix</u>	
	Before	9/16"x 1 15/16"x3 7/8"		9/16"x 1 15/16" x3 7/8"	
After	17/32"x 1 31/32"x3 7/8"		1/2" x 2" x 3 29/32"		
Net Change	-1/32"	+1/32"	0	-1/16" +1/16" + 1/32"	
Percent change	-5.56	+1.61	0.00	-11.11 + 3.23 +0.81	
6 Foot Drop Test	Broke in half on 59th drop			Broke in half on 11th drop	
Stickiness (24 hrs. at 40% humidity and room temp.)	None			None	
Moisture (18 hr vacuum oven)					
Nitrogen pack	20.47			20.53	
Pouch pack	20.95			21.50	
Bacteriology	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>		<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
SPC	600	280		470	290
Coliforms	<10	<10		<10	<10
Yeasts & Molds	<10	<10		<10	<10
Staphylococcus	neg.	neg		neg	neg
<u>Storage Study</u>					
<u>2 Weeks</u>					
<u>35°F</u>					
Organoleptic					
Shear	good			good	
Odor	typical			typical	
Flavor	typical			typical	
<u>73°F.</u>					
Bacteriology					
SPC	600			910	
Coliforms	<10			>10	
Yeasts & Molds	<10			<10	
Staphylococcus	neg.			neg.	
Moisture	21.92			21.56	
Organoleptic					
Shear	good	good		good	good

2 Weeks Cont'd
Organoleptic

	<u>A₃ Matrix</u>		<u>B₂ Matrix</u>	
	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
Odor	typical	typical	typical	typical
Flavor	typical	typical	typical	typical

100°F

Bacteriology

SPC	440	320	290	260
Coliforms	<10	<10	<10	<10
Yeasts & Molds	<10	<10	<10	<10
Moisture %		21.16		19.93

Organoleptic

Shear	good	good	good	good
Odor	typical	typical	typical	typical
Flavor	typical	typical	typical	typical

4 Weeks

35°F

Organoleptic

Shear		Good		Good
Odor		typical		typical
Flavor		typical		typical

73°F

Organoleptic

Shear	good	good	good	good
Odor	typical	typical	typical	typical
Flavor	typical	typical	typical	typical

100°F

Organoleptic

Shear	good	good	good	good
Odor	typical	typical	typical	typical
Flavor	typical	typical	typical	typical

Storage Study

A₃ Matrix
Nitrogen Pack Pouch Pack

B₂ Matrix
Nitrogen Pack Pouch Pack

8 Weeks35°F

Organoleptic

Shear

good

good

odor

typical

typical

Flavor

typical

typical

73°F

Organoleptic

Shear

good

good

good

good

Odor

typical

typical

typical

cooked peaches

Flavor

typical

typical

typical

cooked peaches

100°F

Organoleptic

Shear

good

good

good

good

Odor

typical

typical

typical

typical

Flavor

bitter

typical

typical

typical

13 Weeks35°F

Organoleptic

Shear

good

good

Odor

typical

typical

Flavor

typical

typical

73°F

Organoleptic

Shear

good

good

good

good

Odor

typical

typical

typical

typical

Flavor

typical

typical

typical

typical

100°F

Organoleptic

Shear

good

good

good

good

Odor

cooked peaches

cooked peaches

cooked peaches

cooked peaches

Flavor

bitter

bitter

bitter

bitter

Storage Study cont'd

	A ₃ Matrix		B ₂ Matrix	
	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
<u>26 Weeks</u>				
<u>35°F</u>				
Organoleptic				
Shear		good		good
Odor		typical		typical
Flavor		typical		typical
<u>73°F</u>				
Organoleptic				
Shear	good	good	good	good
Odor	typical	typical	typical	typical
Flavor	typical	typical	typical	typical
<u>100°F</u>				
Organoleptic				
Shear	good	good	good	good
odor	cooked peaches	cooked peaches	cooked peaches	cooked peaches
Flavor	cooked peaches	sl. bitter	cooked peaches	sl. bitter
<u>52 Weeks</u>				
<u>72°F</u>				
Moisture		22.90		21.27
Bacteriology				
SPC	230	70	180	40
Coliforms	<10	<10	<10	<10
Yeasts & Molds	<10	<10	<10	<10
Staphylococcus	neg	neg	neg	neg
Salmonella	neg	neg	neg	neg
<u>100°F</u>				
Moisture		23.44		23.57
Bacteriology				
SPC	740	30	10	20
Coliforms	<10	<10	<10	<10
Yeasts & Molds	<10	<10	<10	<10
Staphylococcus	neg	neg	neg	neg
Salmonella	neg	neg	neg	neg

G. Peanut Bars

1. Formula

Peanuts (Grind "A" medium dry roast, Sachs Nut Co.)	75%
A or B matrix	25%
Water/100 gm. dry material	5 ml
Salt/100 gm dry material	1.5 gm.

2. Procedure:

Peanuts and salt were mixed together until homogenous in a 12 qt. bowl in the A-200 Hobart mixer on speed #2. Water was added by separatory funnel while mixing continued. The respective matrices were added and mixing was continued until homogenous. Depth of fill was adjusted on the Denison hydraulic press so that resulting bars were 1/2" thick. About 120 bars were fabricated at 5000 #g.p. (625 psi.) and zero dwell time. The lower ram was not activated, the total pressure being applied by the upper ram only. This procedure avoided stratification and cracking in the horizontal plane. The bars were finished by drying in a forced air oven for 30' at 120°F. About 100 bars were sealed in aluminized mylar pouches and 21 were packed under nitrogen in glass jars. Pouch stock is 0.5 mil mylar, 0.00035" aluminum foil, and 3 mil polyvinyl chloride. Storage of the pouches bars was begun August 30, 1963, at 100°F, 73°F, 35°F, and 0°F. The nitrogen packed bars were placed in storage at 100°F, 73°F, and 0°F on August 30, 1963.

3. Results: The following test results were obtained initially.

Test	<u>A₃ Matrix</u>	<u>B₂ Matrix</u>
Odor and Flavor	Typical of dry roasted peanuts	Typical of dry roasted peanuts

Mastication

a. Shear by Incisors

(1) 35°F	good	good
(2) 70°F	good	good
(3) 100°F	good	good

b. Chew

(1) 35°F	good	good
(2) 70°F	good	good
(3) 100°F	good	good

Test	<u>A₃ Matrix</u>			<u>B₂ Matrix</u>		
c. Swallow						
(1) 35°F	good			good		
(2) 70°F	good			good		
(3) 100°F	good			good		
6 Foot Drop Test	Broke into 2 pcs. on 2nd drop			Broke into 2 pcs. on 2nd drop		
Stickiness (24 hrs. @ 40% humidity and room temp.)	none			none		
Dimensional Stability (24 hrs. at 120°F and 5 psi.)						
Before	1/2"x2 1/32"x 4 1/32"			17/32" x 2 1/32" x 4 1/16"		
After	15/32 x 2 1/32"x4 1/32"			1/2" x2 1/32" x 4 1/16"		
Net change	-1/32"	0	0	-1/32"	0	0
Percent change	-6.25	0.00	0.00	-5.88	0.00	0.00
Moisture (16 hr vacuum oven)						
Nitrogen Pack	5.47			5.10		
Pouch Pack	5.26			4.86		
Bacteriology	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>		<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	
SPC	500	240		600	260	
Coliforms	<10	<10		<10	<10	
Molds & Yeasts	20	10		10	10	
Staphylococci	neg.	neg.		neg.	neg.	
<u>Storage Study</u>						
<u>2 Weeks</u>						
<u>35°F</u>						
Organoleptic						
Shear	good	good		good	good	
Odor	sl. rancid oil	typical		sl. rancid oil	typical	
Flavor	sl. rancid oil	sl. rancid oil		sl. rancid oil	sl. rancid oil	
<u>73°F.</u>						
Bacteriology						
SPC		700			310	
Coliforms		<10			>10	
Yeasts & Molds		<10			<10	
Staphlococcus		neg			neg	

Storage Study cont'd

	<u>A₃ Matrix</u>		<u>B₂ Matrix</u>	
	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
Moisture		4.52		5.42
Organoleptic				
Shear	good	good	good	good
Odor	rancid oil	sl. rancid oil	rancid oil	sl. rancid oil
Flavor	bitter after taste	sl. rancid oil	bitter after taste	sl. rancid oil

100°F

Bacteriology

SPC	770	280	580	190
Coliforms	<10	<10	<10	<10
Yeasts & Mold.	10	10	5	10

Moisture		5.39		5.32
----------	--	------	--	------

Organoleptic

Shear	good	good	good	good
Odor	rancid oil	rancid oil	rancid oil	rancid oil
Flavor	rancid oil	rancid oil	rancid oil	rancid oil

4 Weeks35°F

Organoleptic

Shear		good		good
Odor		sl. rancid oil		sl. rancid oil
Flavor		sl. rancid oil		sl. rancid oil

73°F

Organoleptic

Shear	good	good	good	good
Odor	rancid oil	rancid oil	rancid oil	rancid oil
Flavor	rancid oil	rancid oil	rancid oil	rancid oil

100°F

Organoleptic

Shear	good	good	good	good
odor	rancid oil	rancid oil	rancid oil	rancid oil
Flavor	rancid oil	rancid oil	rancid oil	rancid oil

Storage Study cont'd

	<u>A₃ Matrix</u>		<u>B₂ Matrix</u>	
	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
Moisture		4.52		5.42
Organoleptic				
Shear	good	good	good	good
Odor	rancid oil	sl. rancid oil	rancid oil	sl. rancid oil
Flavor	bitter after taste	sl. rancid oil	bitter after taste	sl. rancid oil

100°F

Bacteriology

SPC	770	280	580	190
Coliforms	<10	<10	<10	<10
Yeasts & Mold:	10	10	5	10

Moisture		5.39		5.32
----------	--	------	--	------

Organoleptic

Shear	good	good	good	good
Odor	rancid oil	rancid oil	rancid oil	rancid oil
Flavor	rancid oil	rancid oil	rancid oil	rancid oil

4 Weeks

35°F

Organoleptic

Shear		good		good
Odor		sl. rancid oil		sl. rancid oil
Flavor		sl. rancid oil		sl. rancid oil

73°F

Organoleptic

Shear	good	good	good	good
Odor	rancid oil	rancid oil	rancid oil	rancid oil
Flavor	rancid oil	rancid oil	rancid oil	rancid oil

100°F

Organoleptic

Shear	good	good	good	good
odor	rancid oil	rancid oil	rancid oil	rancid oil
Flavor	rancid oil	rancid oil	rancid oil	rancid oil

Storage Study cont'd

	<u>A₃ Matrix</u>		<u>B₂ Matrix</u>	
	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
<u>8 Weeks</u>				
<u>35°F</u>				
Organoleptic				
Shear		good		good
Odor		rancid oil		rancid oil
Flavor		rancid oil		rancid oil
<u>73°F</u>				
Organoleptic				
Shear	good	good	good	good
Odor	sl. rancid oil	rancid oil	rancid oil	rancid oil
Flavor	sl. rancid oil	rancid oil	rancid oil	rancid oil
<u>100°F</u>				
Organoleptic				
Shear	good	good	good	good
Odor	rancid oil	rancid oil	rancid oil	rancid oil
Flavor	rancid oil	rancid oil	rancid oil	bitter
<u>13 Weeks</u>				
<u>35°F</u>				
Organoleptic				
Shear		good		good
Odor		rancid oil		rancid oil
Flavor		rancid oil		rancid oil
<u>73°F</u>				
Organoleptic				
Shear	good	good	good	good
Odor	rancid oil	rancid oil	rancid oil	rancid oil
Flavor	rancid oil	sl bitter	rancid oil	sl. bitter
<u>100°F</u>				
Organoleptic				
Shear	good	good	good	good
Odor	rancid oil	rancid oil	rancid oil	rancid oil
Flavor	bitter	bitter	bitter	bitter

Storage Study cont'd

26 weeks35°F

Organoleptic

Shear

good

good

Odor

sl rancid oil

sl rancid oil

Flavor

sl rancid oil

sl rancid oil

73°F

Organoleptic

Shear

good

good

good

good

Odor

rancid oil

rancid oil

rancid oil

rancid oil

Flavor

rancid oil

rancid oil

rancid oil

rancid oil

100°F

Organoleptic

Shear

good

good

good

good

Odor

rancid oil

rancid oil

acid oil

rancid oil

Flavor

bitter

very bitter

v. bitter

v. bitter

52 Weeks72°F

Moisture

4.74

5.22

Bacteriology

SPC

160

750

70

160

Coliforms

< 10

<10

<10

<10

Yeasts & Molds

<10

10

10

60

Staphylococcus

neg

neg

neg

neg

Salmonella

neg

neg

neg

neg

100°F

Moisture

4.93

5.46

Bacteriology

SPC

1500

130

940

60

Coliforms

<10

<10

<10

<10

yeasts & Molds

<10

<10

<10

<10

Staphylococcus

neg

neg

neg

neg

Salmonella

neg

neg

neg

neg

H. Chicken Bars

1. Formula

Chicken, freeze dried	75%
A ₃ or B ₂ Matrix	25%
Water-glycerine solution (16%)/100 g. dry material	20 ml.

2. Procedure

The chicken was weighed into a 12 qt. bowl on the A-200 Hobart mixer, and the chicken was reduced in particle size on speed #2. The respective matrices were added and the whole mixed until homogenous. The glycerine solution was added by separatory funnel while mixing continued. Depth of fill on the Denison hydraulic press was adjusted so that the resulting bar was 1/2" in thickness. About 120 bars were fabricated with a 6000 #g.p. (750 psi) and a dwell time of "25%-10 sec." and normal action of both upper and lower rams of the press. Bars were dried for 3.5 hrs at 120°F and about 100 were sealed in aluminized PVC pouches (pouch stock: 0.5 mil mylar, 0.00035" aluminum foil, 3 mil mylar) and 21 were sealed under nitrogen in glass jars. Storage at 0°F, 35°F, 73°F, and 100°F was begun on August 30, 1963 for the pouch packed bars. The nitrogen packed bars were placed into storage on August 30, 1963 at 0°F, 73°F, and 100°F.

3. Results: Test results initially were as follows.

<u>Test</u>	<u>A₃ Matrix</u>	<u>B₂ Matrix</u>
Odor and Flavor	Normal to freeze dried chicken	Normal to freeze dried chicken
Mastication		
a. Shear by Incisors		
(1) 35°F	good	good
(2) 70°F	good	good
(3) 100°F	good	good
b. Chew		
(1) 35°F	good	good
(2) 70°F	good	good
(3) 100°F	good	good
c. Swallow		
(1) 35°F	good	good
(2) 70°F	good	good
(3) 100°F	good	good

TableA₃ MatrixB₂ Matrix

Dimensional Stability
(24 hrs. at 120°F and 5 psi)

Before	17/32"x1 31/32"x3 7/8"	1/2" x 2" x 3 29/32"
After	1/2"x 1 15/32"x 3 27/32"	15/32"x 1 31/32"x3 7/8"
Net Change	-1/32" -1/32" -1/32"	-1/32" -1/32" -1/32"
Percent change	-5.88 -1.58 -0.81	-6.25 -1.45 -0.80
6 foot Drop Test	Broke into 3 pieces on 8th drop	Broke into 4 pieces on 4th drop
Stickiness (24 hrs. at 40% humidity and room temp.)	none	none
Moisture (18 hr. vacuum oven)		
Nitrogen pack	10.71	8.11
Pouch pack	9.41	7.76

Bacteriology	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
SPC	900	1080	900	1110
Coliforms	10	5	5	5
Yeasts and Molds	10	20	10	20
Staphylococcus	neg	neg	neg	neg

Storage Study
2 Weeks

35°F

Organoleptic

Shear	good	sl difficult
Odor	typical	typical
Flavor	typical	typical

73°F

Bacteriology

SPC	1450	
Coliforms	>10	
yeasts & molds	10	
Staphylococcus	neg	
Moisture	8.29	8.18

Storage Study cont'd

2 Weeks73°F

	<u>A₃ Matrix</u>		<u>B₂ Matrix</u>	
	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>

Organoleptic

Shear	good	sl difficult	good	difficult
Odor	typical	typical	typical	typical
Flavor	typical	typical	typical	typical

100°F

Bacteriology

SPC	1200	780	550	680
Coliforms	< 10	< 10	< 10	< 10
Yeasts & Molds	30	20	25	25

Moisture

	11.98		8.73
--	-------	--	------

Organoleptic

Shear	difficult	difficult	difficult	good
Odor	typical	typical	typical	acid odor
Flavor	typical	typical	typical	bitter, biting

4 Weeks35°F

Organoleptic

Shear		sl. difficult		sl. difficult
Odor		typical		typical
flavor		typical		typical

73°F

Organoleptic

Shear	good	good	good	good
Odor	typical	typical	typical	typical
Flavor	typical	typical	typical	typical

100°F

Organoleptic

shear	good	good	good	good
odor	typical	typical	typical	typical
Flavor	typical	typical	typical	typical

Storage Study cont'd

8 Weeks

Organoleptic

	<u>A₃ Matrix</u>		<u>B₂ Matrix</u>	
	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
Shear		difficult		difficult
Odor		typical		typical
Flavor		typical		typical

73°F

Organoleptic

Shear	good	good	good	good
Odor	typical	typical	typical	typical
Flavor	typical	typical	typical	typical

100°F

Organoleptic

Shear	difficult	good	good	good
Odor	typical	typical	typical	typical
Flavor	typical/bitter after taste	sl rancid	typical/bitter after taste	typical

13 Weeks35°F

Organoleptic

Shear		good		good
Odor		typical		typical
Flavor		typical		typical

73°F

Organoleptic

Shear	good	good	good	good
Odor	typical	typical	typical	typical
Flavor	typical	typical	typical	typical

100°F

Organoleptic

Shear	good	good	good	good
Odor	cooked chicken	cooked chicken	cooked chicken	cooked chicken
Flavor	typical	typical	typical	typical

Storage Study cont'd
26 Weeks

35° F

	<u>A₃ Matrix</u>		<u>B₂ Matrix</u>	
	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
Organoleptic				
Shear		good		good
Odor		typical		typical
Flavor		typical		typical

73° F

Organoleptic

Shear	good	good	good	good
Odor	typical	stale chicken	typical	stale chicken
Flavor	typical	stale chicken	typical	stale chicken

100° F

Organoleptic

Shear	good	good	good	good
odor	typical	stale chic.	typical	stale chic.
Flavor	stale chic.	stale chic.	stale chic.	stale chic.

5½ Weeks

72° F

Moisture		10.01		7.56
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Bacteriology

SPC	750	360	220	180
Coliforms	<10	20	<10	<10
Yeasts & Molds	30	10	30	10
Staphylococcus	neg	neg	neg	neg
Salmonella	neg	neg	neg	neg

100° F

Moisture		10.80		8.60
----------	--	-------	--	------

Bacteriology

SPC	230	150	250	100
Coliforms	<10	<10	<10	<10
Yeasts & Molds	20	<10	10	10
Staphylococcus	neg	neg	neg	neg
Salmonella	neg	neg	neg	neg

I. Chocolate Bars

1. Formula

Chocolate (Wilbur Chocolate Co. cookie chocolate)	75%
A ₃ or B ₂ matrix	25%
Water/1000 gm dry material	5 ml.

2. Procedure

The chocolate was first comminuted in a Waring blender, then weighed into a 12 qt. Hobart mixing bowl and the appropriate matrix added. The whole was mixed until homogenous on #2 speed of the A-200 Hobart mixer. The water was then added by separatory funnel while mixing continued. Depth of fill on the Denison hydraulic press was adjusted so that resulting bars were 1/2" thick. Bars were fabricated at 4000# g.p. (500 psi) and a dwell time of "15-10 sec." with the lower ram inactivated so that the action of the Carver laboratory press was duplicated. This avoided lamination and cracking of the bar in the horizontal plane. Of the approximately 120 bars fabricated, all of which were dried 20 minutes at 120°F, about 100 were packed in aluminized PVC pouches (pouch stock: 0.5 mil mylar, 0.00035" aluminum foil, 3 mil polyvinyl chloride) and 21 were packed in glass jars under a nitrogen atmosphere. Storage of the pouched bars was begun August 30, 1963 at 0°F, 35°F, 73°F, and 100°F. The nitrogen packed jars began storage on August 30, 1963 also, but at 0°F, 73°F, and 100°F.

3. Results: The following test results were obtained initially.

<u>Test</u>	<u>A₃ Matrix</u>	<u>B₂ Matrix</u>
Odor and Flavor	typical of choc.	typical of choc.

Mastication

a. Shear by Incisors

(1) 35°F	good	good
(2) 70°F	good	good
(3) 100°F	good	good

b. Chew

(1) 35°F	good	good
(2) 70°F	good	good
(3) 100°F	good	good

c. Swallow

(1) 35°F	good	good
(2) 70°F	good	good
(3) 100°F	good	good

Test Cont'dA₃ MatrixB₂ Matrix

6 foot drop test

Broke in half on 4th
dropBroke into 3 pcs on
2nd dropStickiness (24 hrs
at 40% humidity and
room temp.)

none

none

Dimensional Stability
(24 hrs. at 120°F. and
5 psi.)

Before

17/32"x2 1/32"x4 1/32"

1/2"x 2 1/32"x4 1/32"

After

1/2" x 2 1/16"x 4 1/32"

15/32"x2 1/32"x4 1/32"

Net change

-1/32" +1/32" 0

-1/32" 0 0

Percent Change

-5.88 + 1.54 0.00

-6.25 0.00 0.00

MoistureNitrogen pack
Pouch pack6.43
6.536.06
6.09BacteriologyNitrogen PackPouch PackNitrogen PackPouch Pack

SPC

1270

1090

completely
overgrown with
mold before
storage could
be started.

830

Coliforms

<10

<10

<10

Yeasts & Molds

40

30

30

Staphylococcus

neg

neg

neg

Storage Study2 Weeks35°FOrganoleptic

Shear

good

good

Odor

typical

typical

Flavor

typical

typical

73°FBacteriology

SPC

2200

2300

Coliforms

>10

>10

Yeasts & Molds

10

<10

Staphylococcus

neg

neg

Test Cont'dA₃ MatrixB₂ Matrix

6 foot drop test

Broke in half on 4th
dropBroke into 3 pcs on
2nd dropStickiness (24 hrs
at 40% humidity and
room temp.)

none

none

Dimensional Stability
(24 hrs. at 120°F. and
5 psi.)

Before

17/32"x2 1/32"x4 1/32"

1/2"x 2 1/32"x4 1/32"

After

1/2" x 2 1/16"x 4 1/32"

15/32"x2 1/32"x4 1/32"

Net change

-1/32" +1/32" 0

-1/32" 0 0

Percent Change

-5.88 + 1.54 0.00

-6.25 0.00 0.00

Moisture

Nitrogen pack
Pouch pack6.43
6.536.06
6.09

Bacteriology

Nitrogen Pack Pouch PackNitrogen Pack Pouch Pack

SPC

1270

1090

completely
overgrown with
mold before
storage could
be started.

830

Coliforms

<10

<10

<10

Yeasts & Molds

40

30

30

Staphylococcus

neg

neg

neg

Storage Study2 Weeks35°F

Organoleptic

Shear

good

good

Odor

typical

typical

Flavor

typical

typical

73°F

Bacteriology

SPC

2200

2300

Coliforms

>10

>10

Yeasts & Molds

10

<10

Staphylococcus

neg

neg

Storage Study cont'd

2 weeks
73°F

A₃ Matrix

B₂ Matrix

Nitrogen Pack

Pouch Pack

Nitrogen Pack

Pouch Pack

Moisture

6.38

6.27

Organoleptic

Shear

good

good

overgrown
with mold
not tested

good

Odor

typical

typical

typical

Flavor

typical

typical

typical

100°F

Bacteriology

duplicate
sample

SPC

1130

1050 580

overgrown
with mold;
no analysis

Coliforms

<10

<10 <10

Yeasts & Molds

30

30 35

Moisture

6.40

6.30

Organoleptic

Shear

good

good

moldy
not
tested

good

Odor

typical

typical

typical

4 Weeks

35°F

Organoleptic

Shear

good

good

Odor

typical

typical

Flavor

typical

typical

73°F

Organoleptic

Shear

good

good

moldy
not
tested

good

Odor

typical

typical

typical

Flavor

typical

typical

typical

100°F

Organoleptic

Shear

good

good

good
typical

good

Odor

typical

typical

typical

Flavor

typical

typical

typical

typical

Storage Study

8 Weeks

35°F.

Organoleptic

	<u>A₃ Matrix</u>		<u>B₂ Matrix</u>	
	<u>Nitrogen Pack.</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>

Shear

good

good

Odor

typical

typical

Flavor

typical

typical

73°F

Organoleptic

Shear

good

good

moldy

good

odor

typical

typical

not
tested

typical

Flavor

typical

typical

typical

100°F

Organoleptic

Shear

good

good

moldy

good

Odor

typical

stale choc.

not
tested

fruity

Flavor

typical

stale choc.

bitter

13 Weeks35°F

Organoleptic

Shear

good

good

odor

typical

typical

Flavor

typical

typical

73°F

Organoleptic

Shear

good

good

good

good

Odor

typical

typical

typical

typical

Flavor

typical

typical

typical

typical

100°F

Organoleptic

Shear

good

good

moldy

moldy

Odor

typical

typical

no~
testednot
tested

Flavor

typical

typical

Storage Study cont'd

26 weeks35°F.

Organoleptic

	<u>A₃ Matrix</u>		<u>B₂ Matrix</u>	
	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
Shear		good		good
Odor		typical		typical
Flavor		typical		typical

73°F

Organoleptic

Shear	moldy not tested	good	moldy not tested	moldy not tested
Odor		typical		
Flavor		typical		

100°F

Organoleptic

Shear	good	good	moldy not tested	good
Odor	typical	typical		typical
Flavor	typical	typical		typical

52 Weeks72°F

Moisture		6.30		6.53
----------	--	------	--	------

Bacteriology

SPC	570	580	290	790
Coliforms	<10	<10	<10	<10
yeasts & Molds	<10	<10	10	280
Staphylococcus	neg	neg	neg	neg
Salmonella	neg	neg	neg	neg

100°F

Moisture		6.61		6.62
----------	--	------	--	------

Bacteriology

SPC	380	270	810	200
Coliforms	<10	<10	<10	<10
Yeasts & Molds	<10	<10	20	<10
Staphylococcus	neg	neg	neg	neg
Salmonella	neg	neg	neg	neg

J. Bacon Bar

1. Formula

Bacon, Prefried (Wilson, "Bits-o-Bacon"	75%
A ₃ Matrix	25%
Water/100 gm dry materials	5 ml

(Use of B₂ Matrix resulted in an unsatisfactory bar.)

2. Procedure

The bacon was included into the 12 qt bowl of the Hobart A-200 mixer, and while mixing on speed #2, the water was added by separatory funnel. The matrix was then added, and mixing was continued until homogeneity obtained. The depth of fill on the Denison hydraulic press was adjusted so that resulting bars were 1/2" thick. About 120 bars were fabricated at 3000 #g.p. (375 ps.) with a dwell time of "30%-10 sec." After these were dried at 120°F for 30 minutes about 100 were sealed in aluminumized PVC pouches (pouch stock: 0.5 mil mylar, 0.00035" aluminum foil, 3 mil polyvinyl chloride) and 21 were sealed under nitrogen in glass jars. Storage at 0°F, 35°F, 73°F, and 100°F of the pouch packed bars was begun on August 30, 1963 also, but at 0°F, 73°F, and 100°F.

3. Results

Initial test results were as follows:

<u>Test</u>	<u>A₃ Matrix</u>
Odor & Flavor	Normal to Wilson prefried bacon
Mastication	
a. Shear by incisors	
(1) 35°F	Good
(2) 70°F	Good
(3) 100°F	Good
b. Chew	
(1) 35°F	Good
(2) 70°F	Good
(3) 100°F	Good

Test

Mastication - cont'd

A3 Matrix

c. Swallow

(1) 35°F	Good
(2) 70°F	Good
(3) 100°F	Good

Dimension Stability (24 hrs.
at 120°F and 5 psi).

Before	17/32" x 2" x 4"
After	1/2 " x 2-1/32" x 4"
Net Change	-1/32" +1/32" 0"
Percent Change	-5.88 +1.56 0.00

6 Foot Drop Test

Broke into 4 pieces on 3 rd drop

Stickiness (24 hrs. at 40%
humidity and room tem.)

None

Moisture (16 hr. vacuum oven)

Nitrogen Pack	12.98%
Pouch Pack	14.04%

Bacteriology

Nitrogen Pack

Pouch Pack

SPC	2100	2410
Coliforms	<10	<5
Yeasts & Molds	20	50
Staphylococcus	Neg.	Neg.

Storage Study

2 Weeks

Nitrogen Pack

Air Pack

35°F

Organoleptic

Shear	-	Good
Odor	-	Typical
Flavor	-	Typical

Storage Study - cont'd.

A₃ Matrix2 WeeksNitrogen PackAir Pack73°F

Bacteriology

SPC	-	>3000
Coliforms	-	<10
Yeasts & Molds	-	<10
Staphylococcus	-	Neg.

Moisture

- 13.28

Organoleptic

Shear	Good	Good
Odor	Typical	Typical
Flavor	Typical	Typical

100°F

Bacteriology

SPC	2260	1480
Coliforms	<10	>10
Yeasts & Molds	45	30

Moisture

- 14.46

Organoleptic

Shear	Good	Good
Odor	Typical	Typical
Flavor	Typical	Typical

4 Weeks35°F

Organoleptic

Shear	-	Good
Odor	-	Typical
Flavor	-	Typical

Storage Study - cont'd.

A3 Matrix4 WeeksNitrogen PackAir Pack73°F

Organoleptic

Good

Good

Odor

Typical

Typical

Flavor

Typical

Typical

100°F

Organoleptic

Shear

Good

Good

Odor

Typical

Typical

Flavor

Typical

Typical

8 Weeks35°F

Organoleptic

Shear

-

Good

Odor

-

Typical

Flavor

-

Typical

73°F

Organoleptic

Shear

Good

Good

Odor

Typical

Typical

Flavor

Typical

Typical

100°F

Organoleptic

Shear

Good

Good

Odor

Burned bacon

Rubber

Flavor

Burned bacon

Rubber

13 WeeksNitrogen PackAir Pack35°F

Organoleptic

Shear	-	Good
Odor	-	Typical
Flavor	-	Typical

73°F

Organoleptic

Shear	Good	Good
Odor	Typical	Typical
Flavor	Typical	Typical

100°F

Organoleptic

Shear	Good	Good
Odor	Typical	Burned bacon
Flavor	Burned	Bitter

26 Weeks35°F

Organoleptic

Shear	-	Good
Odor	-	Typical
Flavor	-	Typical

73°F

Organoleptic

Shear	Good	Good
Odor	Typical	Burned
Flavor	Typical	Burned

Storage Study - cont'd.

A₃ Matrix26 WeeksNitrogen PackAir Pack100° F

Organoleptic

Shear

Good

Good

Odor

Typical

Burned

Flavor

Typical

Burned

52 Weeks72° F

Moisture

-

14.85

Bacteriology

SPC

320

920

Coliforms

<10

<10

Yeasts & Molds

20

<10

Staphylococcus

Neg.

Neg.

Salmonella

Neg.

Neg.

100° F

Moisture

15.26

Bacteriology

SPC

930

170

Coliforms

<10

<10

Yeasts & Molds

10

<10

Staphylococcus

Neg.

Neg.

Salmonella

Neg.

Neg.

K. Raisin Bars

1. Formula

Raisins, Myvacet coated, Sunmaid

75%

A₃ or B₂ Matrix

25%

Water/100 gm dry material

5 ml

2. Procedure

Water was added to the raisins in a 5 qt Hobart mixer bowl and mixed by hand to thoroughly wet the surfaces of the raisins. (Attempts to wet the raisins by means of the paddle on #1 speed failed because too many raisins were cut up by the paddle). The respective matrices were added and the whole mixed for 15 seconds on speed #1 of the Hobart N-50 mixer. Eighty gram portions were weighed into the 4" x 2" x 1/2" die on a Carver laboratory press, and the hydraulic pressure was increased to the point where the gauge needle just began to move. The resulting bars were then dried at 120°F for 20 minutes. About 100 bars were sealed in aluminized mylar pouches (pouch stock: 0.5 mil mylar, 0.00035" aluminum foil and 3 mil polyvinyl chloride), and 21 were packed under nitrogen in glass jars. Storage of the pouched bars was begun on August 30, 1963 at 100°F, 73°F, 35°F and 0°F. The nitrogen packed bars began storage at 100°F, 73°F, and 0°F on August 30, 1963.

3. Results

The following test results were obtained initially.

<u>Test</u>	<u>A₃ Matrix</u>	<u>B₂ Matrix</u>
Odor & Flavor	Typical of Raisins	Typical of Raisins
Mastication		
a. Shear by Incisors		
(1) 35°F	Good	Good
(2) 70°F	Good	Good
(3) 100°F	Good	Good
b. Chew		
(1) 35°F	Good	Good
(2) 70°F	Good	Good
(3) 100°F	Good	Good
c. Swallow		
(1) 35°F	Good	Good
(2) 70°F	Good	Good
(3) 100°F	Good	Good

Test - cont'd.

A₃ Matrix

B₂ Matrix

6 Foot Drop Test Broke in half on 21st drop Broke in 3 pcs on 10th drop

Stickiness (24 hrs
at 40% humidity and
room temp.)

None

None

Dimensional Stability
(24 hrs at 120°F and
5 psi)

Before	9/16" x 1-31/32" x 3-7/8"			9/16" x 1-31/32" x 3-13/16"		
After	17/32" x 1-31/32" x 3-7/8"			17/32" x 1-31/32" x 3-27/32"		
Net Change	-1/32"	0	0	-1/32"	+1/16"	+1/32"
Percent Change	-5.56	0.00	0.00	-5.56	+3.07	+0.83

Moisture

Nitrogen Pack	13.99	13.91
Pouch Pack	14.68	14.00

Bacteriology	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
SPC	820	720	1040	680
Coliforms	>10	<10	>10	<10
Yeasts & Molds	<10	<10	10	<10
Staphylococcus	Neg.	Neg.	Neg.	Neg.

Storage Study

2 Weeks

35°F.

Organoleptic

Shear	-	-	Good	Good
Odor	-	-	Typical	Typical
Flavor	-	-	Typical	Typical

73°F

Bacteriology

SPC	600	260
Coliforms	>10	>5
Yeasts & Molds	<10	<10
Staphylococcus	Neg.	Neg.

Storage Study - cont'd.

A₃ MatrixB₂ Matrix2 WeeksNitrogen PackPouch PackNitrogen PackPouch Pack73°F

Moisture

14.69

14.29

Organoleptic

Shear

Good

Difficult

Good

Good

Odor

Typical

Typical

Typical

Typical

Flavor

Typical

Typical

Typical

Typical

100°F

Bacteriology

SPC

710

740

Coliforms

<10

<10

Yeasts & Molds

<10

<10

Moisture

15.22

14.72

Organoleptic

Shear

Good

Good

Good

Good

Odor

Typical

Typical

Typical

Typical

Flavor

Typical

Typical

Typical

Typical

4 Weeks35°F

Organoleptic

Shear

-

Good

-

Good

Odor

-

Typical

-

Typical

Flavor

-

Typical

-

Typical

73°F

Organoleptic

Shear

Good

Good

Good

Good

Odor

Typical

Typical

Typical

Typical

Flavor

Typical

Typical

Typical

Typical

Storage Study - cont d.

A3 Matrix~~B2~~ Matrix4 WeeksNitrogen PackPouch PackNitrogen PackPouch Pack100°F

Organoleptic

Shear	Good	Good	Good	Good
Odor	Typical	Typical	Typical	Typical
Flavor	Typical	Typical	Typical	Typical

8 Weeks35°F

Organoleptic

Shear	-	Good	-	Good
Odor	-	Typical	-	Typical
Flavor	-	Typical	-	Typical

73°F

Organoleptic

Shear	Good	Good	Good	Good
Odor	Typical	Typical	Typical	Typical
Flavor	Typical	Typical	Typical	Typical

100°F

Organoleptic

Shear	Good	Good	Good	Good
Odor	Honey-like	Honey-like	Honey-like	Honey-like
Flavor	Typical	Bitter	Typical	Metallic

13 Weeks35°F

Organoleptic

Shear	-	Good	-	Good
Odor	-	Typical	-	Typical
Flavor	-	Typical	-	Typical

Storage Study - cont'd.

A3 MatrixB2 Matrix4 WeeksNitrogen PackPouch PackNitrogen PackPouch Pack100°F

Organoleptic

Shear	Good	Good	Good	Good
Odor	Typical	Typical	Typical	Typical
Flavor	Typical	Typical	Typical	Typical

8 Weeks35°F

Organoleptic

Shear	-	Good	-	Good
Odor	-	Typical	-	Typical
Flavor	-	Typical	-	Typical

73°F

Organoleptic

Shear	Good	Good	Good	Good
Odor	Typical	Typical	Typical	Typical
Flavor	Typical	Typical	Typical	Typical

100°F

Organoleptic

Shear	Good	Good	Good	Good
Odor	Honey-like	Honey-like	Honey-like	Honey-like
Flavor	Typical	Bitter	Typical	Metallic

13 Weeks35°F

Organoleptic

Shear	-	Good	-	Good
Odor	-	Typical	-	Typical
Flavor	-	Typical	-	Typical

Storage Study - cont'd.

A₃ MatrixB₂ Matrix13 WeeksNitrogen PackPouch PackNitrogen PackPouch Pack73°F

Organoleptic

Shear	Good	Good	Good	Good
Odor	Honey-like	Typical	Typical	Typical
Flavor	Typical	Typical	Typical	Typical

100°F

Organoleptic

Shear	Good	Good	Good	Good
Odor	Honey-like	Honey-like	Honey-like	Honey-like
Flavor	Bitter	Bitter	Bitter	Bitter

26 Weeks35°F

Organoleptic

Shear	-	Good	-	Good
Odor	-	Typical	-	Typical
Flavor	-	Typical	-	Typical

73°F

Organoleptic

Shear	Good	Good	Good	Good
Odor	Typical	Typical	Typical	Typical
Flavor	Typical	Typical	Typical	Typical

100°F

Organoleptic

Shear	Good	Good	Good	Good
Odor	Typical	Typical	Typical	Typical
Flavor	Typical	Typical	Typical	Typical

Storage Study - cont'd.

<u>52 Weeks</u>	<u>A₃ Matrix</u>		<u>B₂ Matrix</u>	
	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
<u>72°F</u>				
Moisture		14.42		14.57
Bacteriology				
SPC	220	210	160	150
Coliforms	<10	<10	<10	<10
Yeasts & Molds	<10	10	<10	<10
Staphylococcus	Neg.	Neg.	Neg.	Neg.
Salmonella	Neg.	Neg.	Neg.	Neg.
<u>100°F</u>				
Moisture		16.55		15.92
Bacteriology				
SPC	<10	0	10	30
Coliforms	<10	<10	<10	<10
Yeasts & Molds	<10	<10	<10	<10
Staphylococcus	Neg.	Neg.	Neg.	Neg.
Salmonella	Neg.	Neg.	Neg.	Neg.

L. Fruit Preserves at 20% Moisture

No food bar could be made by compression using either matrix and fruit preserves at 20% moisture. All attempts to mix the matrices intimately with the fruit preserves resulted in a toffee-like mass whose surface was quite sticky. Bars could be molded from this material by hand but not by using the Carver laboratory press (and therefore not by the Denison press either), even where the punches of the die were coated with release paper. The hand molded bars were quite plastic and would fail the 5 psi dimensional stability test and the stickiness test. Consequently, because this food bar would not lend itself to compression forming, no fruit preserves bars were manufactured.

M. Herring Bars

1. Formula

Herring, Dried Smoked	75%
A ₃ Matrix	25%
Water/100 gm Dry Material	5 mil

(Attempts at using B₂ Matrix were not successful with this product.)

2. Procedure

The herring was comminuted on a Waring blender, mixed intimately with the matrix in a 12 qt bowl on the A-200 Hobart mixer on speed #2, and the water was added by separatory funnel while mixing continued. Depth of fill on the Denison hydraulic press was adjusted so that the resulting bars were 1/2" thick. Bars were then pressed at 3000 #gp (375 psi) and a dwell time of "30%-10 sec." with only the upper ram activated. This prevented stratification (cracking of the bar in the horizontal plane). The resulting bars were dried at 120°F for 20'. Approximately 100 bars were sealed in aluminized mylar pouches (pouch stock: 0.5 mil mylar, 0.00035" aluminum foil and 3 mil polyvinyl chloride) and 21 were packed under nitrogen in glass jars. Storage of the pouched bars began August 30, 1963 at 100°F, 73°F, 35°F and 0°F. The nitrogen packed bars began storage at 100°F, 73°F and 0°F on August 30, 1963.

3. Results

The following test results were obtained initially.

Test

Odor & Flavor	Typical of dried, smoked herring	j
Mastication		.
a. Shear by Incisors		s
(1) 35°F	Good	{
(2) 70°F	Good	1
(3) 100°F	Good	1
b. Chew		
(1) 35°F	Good	:
(2) 70°F	Good	
(3) 100°F	Good	

Test - cont'd.

A₃ Matrix

Mastication

c. Swallow

(1) 35°F	Good
(2) 70°F	Good
(3) 100°F	Good

6 Foot Drop Test

Broke into 2 pcs on 12th drop

Stickiness (24 hrs @
120°F and 5 psi)

Before	9/16" x 2" x 4"
After	7/16" x 2" x 4"
Net Change	-1/8" 0 0
Percent Change	-22.22 0.00 0.00

Moisture (16 hr
vacuum oven)

Nitrogen Pack	29.76
Pouch Pack	33.86

Bacteriology

Nitrogen Pack

Pouch Pack

SPC	1220	1150
Coliforms	<10	<10
Yeasts & Molds	30	60
Staphylococcus	Neg.	Neg.
Salmonella	Neg.	Neg.

Storage Study

2 Weeks

35°F

Organoleptic

Shear	-	Good
Odor	-	Typical
Flavor	-	Typical

2 WeeksNitrogen PackPouch Pack73°F

Bacteriology

SPC

630

Coliforms

< 10

Yeasts & Molds

< 10

Staphylococcus

Neg.

Moisture

12.92

Organoleptic

Shear

Good

Good

Odor

Typical

Typical

Flavor

Typical

Typical

100°F

Bacteriology

SPC

>90

Coliforms

< 10

Yeasts & Molds

50

Moisture

11.50

Organoleptic

Shear

Good

Good

Odor

Typical

Typical

Flavor

Typical

Typical

4 Weeks35°F

Organoleptic

Shear

-

Good

Odor

-

Typical

Flavor

-

Typical

4 WeeksNitrogen PackPouch Pack73°F

Organoleptic

Shear

Good

Good

Odor

Typical

Typical

Flavor

Typical

Typical

100°F

Organoleptic

Shear

Good

Good

Odor

Typical

Typical

Flavor

Typical

Typical

8 Weeks35°F

Organoleptic

Shear

-

Good

Odor

-

Typical

Flavor

-

Typical

73°F

Organoleptic

Shear

Good

Good

Odor

Typical

Typical

Flavor

Typical

Typical

100°F

Organoleptic

Shear

Good

Good

Odor

Typical

Burned herring

Flavor

Typical

Burned herring

13 WeeksNitrogen PackPouch Pack35° F

Organoleptic

Shear	-	Good
Odor	-	Typical
Flavor	-	Typical

73° F

Organoleptic

Shear	Good	Good
Odor	Typical	Typical
Flavor	Typical	Typical

100° F

Organoleptic

Shear	Good	Good
Odor	Typical	Typical
Flavor	Sl. bitter	Sl. bitter

26 Weeks35° F

Organoleptic

Shear	-	Good
Odor	-	Typical
Flavor	-	Typical

73° F

Organoleptic

Shear	Good	Good
Odor	Typical	Typical
Flavor	Typical	Typical

26 WeeksNitrogen PackPouch Pack100°F

Organoleptic

Shear	Good	Considerable
Odor	Burned fish	Gas in pouch
Flavor	Bitter; obnoxious	Not tested

52 Week72°F

Moisture	31.52
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Bacteriology

SPC	2250	500
Coliforms	<10	<10
Yeasts & Molds	45	<10
Staphylococcus	Neg.	Neg.
Salmonella	Neg.	Neg.

100°F

Moisture	34.08
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Bacteriology

SPC	220	190
Coliforms	<10	<10
Yeasts & Molds	<10	<10
Staphylococcus	Neg.	Neg.
Salmonella	Neg.	Neg.

N. Precoked Egg Bars

1. Formula

Precoked Freeze Dried Egg	75%
A ₃ or B ₂ Matrix	25%
Water/100 gm Dry Materials	5 ml
Salt/100 gm Dry Materials	1 gm

2. Procedure

The egg, matrix, and salt were mixed until homogenous on speed #2 of the A-200 Hobart mixer. Water was then added to the 12 qt bowl by separatory funnel while mixing was continued. Depth of fill on the Denison hydraulic press was adjusted so that the resulting bar was 1/2" thick. About 120 bars were fabricated at "5500# g.p." (687.5 psi) with a dwell time of "15%-10 sec." and normal action of both upper and lower rams of the press. Bars were dried 120°F for 20 minutes and about 100 were sealed into aluminized PVC pouches (pouch stock: 0.5 mil mylar, 0.00035" aluminum foil, 3 mil polyvinyl chloride) and 21 were sealed under nitrogen in glass jars. Storage of the pouched bars began on August 30, 1963 at 0°F, 35°F, 73°F, and 100°F, and the nitrogen packed bars were placed in storage at 0°F, 73°F and 100°F on August 30, 1963.

3. Results

The following test results were obtained initially.

<u>Test</u>	<u>A₃ Matrix</u>	<u>B₂ Matrix</u>
Odor & Flavor	Typical of Eggs	Typical of Eggs
Masticiation		
a. Shear by Incisors		
(1) 35°F	Good	Good
(2) 70°F	Good	Good
(3) 100°F	Good	Good
b. Chew		
(1) 35°F	Good	Good
(2) 70°F	Good	Good
(3) 100°F	Good	Good
c. Swallow		
(1) 35°F	Good	Good
(2) 70°F	Good	Good
(3) 100°F	Good	Good
6 Foot Drop Test	Broke in half on 1st drop	Broke in half on 1st drop

Test - cont'd.

A₃ Matrix

B₂ Matrix

Stickiness (24 hrs
at 40% humidity
and room temp.)

None

None

Dimensional Stabi-
lity (24 hrs at
120°F and 5 psi)

Before	17/32" x 2-1/32" x 4-1/32"	9/16" x 2-1/32" x 4-1/32"
After	1/2" x 2 x 4-1/32"	17/32" x 2" x 4"
Net Change	-1/32" -1/32" 0	-1/32" -1/32" -1/32"
Percent Change	-5.88 -1.54 0.00	-5.88 -1.53 -0.78

Moisture (16 hr.
vacuum oven)

Nitrogen Pack	5.36	5.26
Pouch Pack	5.42	5.19

Bacteriology	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
SPC	1260	430	840	830
Coliforms	<10	>10	>10	<10
Staphylococcus	Neg.	Neg.	Neg.	Neg.
Yeasts & Molds	40	70	50	30
Salmonella	Neg.	Neg.	Neg.	Neg.

Storage Study

2 Weeks

35°F

Organoleptic

Shear	-	Good	-	Good
Odor	-	Typical	-	Typical
Flavor	-	Typical	-	Typical

73°F

Bacteriology

SPC	2090	1550
Coliforms	<10	<10
Yeasts & Molds	<10	<10
Staphylococcus	Neg.	Neg.

2 WeeksNitrogen PackPouch PackNitrogen PackPouch Pack73°F

Moisture

5.48

5.28

Organoleptic

Shear

Good

Good

Good

Good

Odor

Typical

Typical

Typical

Typical

Flavor

Typical

Typical

Typical

Typical

100°F

Bacteriology

SPC

770

580

520

550

Coliforms

>10

>10

>10

>10

Yeasts & Molds

45

75

65

65

Moisture

5.66

4.62

Organoleptic

Shear

Good

Good

Good

Good

Odor

Acrid

Acrid

Acrid

Acrid

Flavor

Bitter

Biting

Bicter

Biting

4 Weeks35°F

Organoleptic

Shear

-

Good

-

Good

Odor

-

Typical

-

Typical

Flavor

-

Typical

-

Typical

73°F

Organoleptic

Shear

Good

Good

Good

Good

Odor

Typical

Typical

Typical

Typical

Flavor

Typical

Typical

Typical

Typical

Storage Test - cont'd.

A₃ MatrixB₂ Matrix4 WeeksNitrogen PackPouch PackNitrogen PackPouch Pack100°F

Organoleptic

Shear	Good	Good	Good	Good
Odor	Typical	Typical	Typical	Typical
Flavor	Typical	Typical	Typical	Typical

8 Weeks35°F.

Organoleptic

Shear	-	Good	-	Good
Odor	-	Typical	-	Typical
Flavor	-	Typical	-	Typical

73°F

Organoleptic

Shear	Good	Good	Good	Good
Odor	Typical	Typical	Typical	Typical
Flavor	Typical	Typical	Typical	Typical

100°F

Organoleptic

Shear	Good	Good	Good	Good
Odor	Sl. rancid	Typical	Typical	Typical
Flavor	Very bitter	Typical	Typical	Typical

13 Weeks35°F

Organoleptic

Shear	-	Good	-	Good
Odor	-	Typical	-	Typical
Flavor	-	Typical	-	Typical

Storage Study - cont'd.

A3 MatrixB2 Matrix13 WeeksNitrogen PackPouch PackNitrogen PackPouch Pack13°F

Organoleptic

Shear

Good

Good

Good

Good

Odor

Typical

Typical

Typical

Typical

Flavor

Typical

Typical

Typical

Typical

160°F

Organoleptic

Shear

Good

Good

Good

Good

Odor

Typical

Typical

Typical

Typical

Flavor

Typical

Typical

Typical

Typical

26 Weeks35°F

Organoleptic

Shear

-

Good

-

Good

Odor

-

Typical

-

Typical

Flavor

-

Typical

-

Typical

73°F

Organoleptic

Shear

Good

Good

Good

Good

Odor

Typical

Typical

Typical

Typical

Flavor

Good

Stale Egg

Good

Stale Egg

100°F

Organoleptic

Shear

Good

Good

Good

Good

Odor

Good

Good

Good

Good

Flavor

Stale Egg

Sl. Bitter

Stale Egg

Sl. Bitter

Storage Study - cont'd.

A₃ MatrixB₂ Matrix52 WeeksNitrogen PackPouch PackNitrogen PackPouch Pack72° F

Moisture

5.03

5.42

Bacteriology

SPC

1090

1110

780

370

Coliforms

<10

<10

20

20

Yeasts & Molds

20

40

70

60

Staphylococcus

Neg.

Neg.

Neg.

Neg.

Salmonella

Neg.

Neg.

Neg.

Neg.

100° F

Moisture

6.23

5.56

Bacteriology

SPC

440

160

410

210

Coliforms

<10

<10

<10

<10

Yeasts & Molds

20

10

80

30

Staphylococcus

Neg.

Neg.

Neg.

Neg.

Salmonella

Neg.

Neg.

Neg.

Neg.

O. Romano Cheese Bar

1. Formula

Romano Cheese, Grated

75%

A₃ Matrix

25%

Water/100 gm Dry Material

5 m

(B₂ Matrix did not make a satisfactory bar.)

2. Procedure

The cheese and matrix were weighed into a 12 qt Hobart mixer bowl and mixed on speed #2 of the A-200 Hobart until homogenous. The water was added by separatory funnel while mixing. Depth of fill on the Denison hydraulic press was adjusted so that resulting bars were 1/2" thick. Bars were fabricated at "2500 #g.p." (312.5 psi), and a dwell time

of "25%-10 sec." and normal action of both upper and lower rams. From a total of about 120 bars which were dried at 120°F for 20 minutes, about 100 were sealed in aluminized PVC pouches (pouch stock: 0.5 mil mylar, 0.00035" aluminum foil, and 3 mil polyvinyl chloride) and about 21 were packed under nitrogen in glass jars. Pouched bars began storage on August 30, 1963 at 0°F, 35°F, 73°F, and 100°F. Nitrogen packed bars were placed in storage on August 30, 1963 at 0°F, 73°F, and 100°F.

3. Results

The following test results were obtained initially.

<u>Test</u>	<u>A₃ Matrix</u>
Odor & Flavor	Typical of Romano Cheese
Mastication	
a. Shear by Incisors	
(1) 35°F	Good
(2) 70°F	Good
(3) 100°F	Good
b. Chew	
(1) 35°F	Good
(2) 70°F	Good
(3) 100°F	Good
c. Swallow	
(1) 35°F	Good
(2) 70°F	Good
(3) 100°F	Good
Six Foot Drop Test	Broke into 3 pieces on 2nd drop
Stickiness (24 hrs at 40% humidity and room temp.)	None
Dimensional Stability (24 hrs at 120°F and 5 psi)	
Before	1/2" x 1-31/32" x 3-29/32"
After	1/2" x 1-31/32" x 3-29/32"

Test - cont'd.

A3 Matrix

Dimensional Stability (24 hrs
at 120°F and 100 psi)

Net Change	0	0	0
Percent Change	0.00	0.00	0.00

Moisture (16 hr vacuum oven)

Nitrogen Pack	14.51
Pouch Pack	13.56

Bacteriology	<u>Nitrogen Pack</u>	<u>Pouch Pack</u>
SPC	1870	2180
Coliforms	<10	<10
Yeasts & Molds	<10	20
Staphylococcus	Neg.	Neg.

Storage Study

2 Weeks

35°F

Organoleptic

Shear	-	Good
Odor	-	Typical
Flavor	-	Sl. sour

73°F

Bacteriology

SPC	1390
Coliforms	<10
Yeasts & Molds	<10
Staphylococcus	Neg.

Moisture	14.60
----------	-------

Organoleptic

Shear	Good	Good
Odor	Typical	Typical
Flavor	Typical	Typical

2 WeeksNitrogen PackPouch Pack100° F

Bacteriology

SPC

1490

910

Coliforms

< 10

< 10

Yeasts & Molds

35

10

Moisture

13.41

Organoleptic

Shear

Good

Good

Odor

Typical

Typical

Flavor

Typical

Typical

4 Weeks35° F

Organoleptic

Shear

-

Good

Odor

-

Typical

Flavor

-

Typical

73° F

Organoleptic

Shear

Good

Good

Odor

Typical

Typical

Flavor

Typical

Typical

100° F

Organoleptic

Shear

Good

Good

Odor

Burned cheese

Burned cheese

Flavor

Bitter

Burned cheese

8 WeeksNitrogen PackPouch Pack35°F

Organoleptic

Shear

-

Good

Odor

-

Typical

Flavor

-

Typical

73°F

Organoleptic

Shear

Good

Good

Odor

Typical

Typical

Flavor

Typical

Bitter

100°F

Shear

Good

Good

Odor

Burned cheese

Burned cheese

Flavor

Bitter

Bitter

13 Weeks35°F

Organoleptic

Shear

-

Good

Odor

-

Typical

Flavor

-

Typical

73°F

Organoleptic

Shear

Good

Good

Odor

Typical

Typical

Flavor

Typical

Bitter

100°F

Organoleptic

Shear

Good

Good

Odor

Burned cheese

Burned cheese

Flavor

Bitter

Bitter

26 WeeksNitrogen PackPouch Pack35°F

Organoleptic

Shear	-	Good
Odor	-	Typical
Flavor	-	Typical

73°F

Organoleptic

Shear	Good	Good
Odor	Typical	Typical
Flavor	Typical	Typical

100°F

Organoleptic

Shear	Good	Gas in pouch
Odor	Burned cheese	Not tested
Flavor	Bitter; obnoxious	Not tested

52 Weeks72°F

Moisture

16.75

Bacteriology

SPC	270	180
Coliforms	<10	5
Yeasts & Molds	<10	<10
Staphylococcus	Neg.	Neg.
Salmonella	Neg.	Neg.

100°F

Moisture

16.04

52 Weeks

Nitrogen Pack

Pouch Pack

100°F.

Bacteriology

SPC	340	50
Coliforms	< 10	< 10
Yeasts & Molds	< 10	< 10
Staphylococcus	Neg.	Neg.
Salmonella	Neg.	Neg.

III. Complete Food Bars (Phase II)

A. Beef Stew Food Bars

1. Formula	%
Beef Cubes, Freeze-dried (Wilson)	40.00
B ₂ Matrix	21.00
Potato Flakes, Pillsbury	14.50
Celery, Freeze-dried, C.V.C.	2.00
Peas, Whole, Freeze-dried, C.V.C.	6.65
Corn, Whole, Freeze-dried, C.V.C.	6.00
Onion Flakes, Dried, Durkee	1.50
Salt, Flour	2.00
Pepper, Black, Ground, Malbar	0.25
Tomato Powder, I.D.I.T. S.p.A.	5.00
Monosodium Glutamate, Merck	1.00
Caramel Color	<u>0.10</u>
	100.00
Water per 100 gm dry ingredients	10.6 ml

2. Procedure

a. The beef was added to the 12 qt bowl of an A-200 Hobart mixer and

shredded.

b. The remainder of the dry ingredients were added and the whole mixed until homogenous.

c. Water, previously measured, was added while mixing continued by means of a separatory funnel.

d. The resulting 1600 gm batch was pressed into bars on the Denison Hydraulic Press at 5 tons pressure with a dwell time of 2-3 sec.

e. The finished bars were dried for 4 hours in a forced air oven at 130°F.

f. The bars were then sealed in aluminized PVC pouches under air and under nitrogen atmospheres.

3. Results

a. Odor and flavor - acceptable in dry bars and in stew reconstituted at 40% solids.

b. Six foot drop test - good (only about 1/20 of the bar broke off one corner).

c. Stickiness (24 hours at room temperature and 40% relative humidity) - none.

d. Mastication

Temp. - °F.	35	70	100
Shear	good	good	good
Chew	good	good	good
Swallow	good	good	good

e. Dimensional Stability (24 hrs at 120°F 5 psi)

Before	17/32"	x	2-1/32"	x	4-1/32"
After	1/2"	x	2-1/32"	x	4-1/32"
Percent Change	-5.88	0	0		

f. Moisture 3.81%

4. Storage Studies

Storage Studies - cont'd.

a.	<u>2 Weeks</u>	Air Pack			Nitrogen Pack		
	Temp (°F)	35	73	100	35	73	100
	(1) Shear	Good	Good	Good	Good	Good	Good
	(2) Odor	Good	Good	Good	Good	Good	Good
	(3) Flavor	Good	Good	Good	Good	Good	Good
	(4) Stew	Good	Good	Good	Good	Good	Good
b.	<u>4 Weeks</u>						
	(1) Shear	Good	Good	Good	Good	Good	Good
	(2) Odor	Good	Good	Good	Good	Good	Good
	(3) Flavor	Good	Good	Good	Good	Good	Good
	(4) Stew	Good	Good	Good	Good	Good	Good
	(5) Moisture		3.77	3.74			
c.	<u>8 Weeks</u>						
	(1) Shear	Good	Good	Good	Good	Good	Good
	(2) Odor	Good	Good	Good	Good	Good	Good
	(3) Flavor	Good	Good	Good	Good	Good	Good
	(4) Stew	Good	Good	Good	Good	Good	Good
d.	<u>13 Weeks</u>						
	(1) Shear	Good	Good	Good	Good	Good	Good
	(2) Odor	Good	Good	Good	Good	Good	Good
	(3) Flavor	Good	Good	Good	Good	Good	Good
	(4) Stew	Good	Good	Good	Good	Good	Good
	(5) Moisture		3.70	3.91			
	(6) Bacteriology						
	SPC		1400	1130			1120
	Coliforms		Neg.	Neg.			Neg.
	Molds & Yeasts		140	320			260

B. Barbecued Ground Beef Food Bar

1. Formula	%
Beef, Precooked, Freeze-dried, 3/16" Grind, Wilson	53.00
B ₂ Matrix	25.00
Barbecue Sauce (ref. Para. IV D, p. 14)	12.00
Tomato Powder, I.D.I.T. S.p.A.	<u>10.00</u>
	100.00

Water per 100 gm Dry Ingredients 10 ml

Buffer per 100 gm Dry Ingredients 0.32 Sodium Bicarbonate

2. Procedure

a. All dry ingredients were weighed into a 12 qt bowl on an A-200 Hobart mixer.

b. The whole was mixed until uniform and water was added by separatory funnel while mixing continued.

c. Bars were then pressed on the Denison Hydraulic Press at 3 tons pressure and a dwell time of 1.5 sec.

d. The resulting bars were dried for 4 hrs in a forced air oven at 130°F.

e. The finished bars were then packed under air and nitrogen atmospheres in aluminized PVC pouches.

3. Results

a. Odor and flavor - acceptable in dry bars and in stew reconstituted at 40% solids.

b. Six foot drop test -good (broke in halves).

c. Stickiness (24 hrs at room temperature and 40% relative humidity) - none.

d. Mastication

Temp °F	35	70	100
Shear	good	good	good
Chew	good	good	good
Swallow	good	good	good

B. Barbecued Ground Beef Food Bar

1. Formula	%
Beef, Precooked, Freeze-dried, 3/16" Grind, Wilson	53.00
B ₂ Matrix	25.00
Barbecue Sauce (ref. Para. IV D, p. 14)	12.00
Tomato Powder, I.D.I.T. S.p.A.	<u>10.00</u>
	100.00

Water per 100 gm Dry Ingredients 10 ml

Buffer per 100 gm Dry Ingredients 0.32 Sodium Bicarbonate

2. Procedure

a. All dry ingredients were weighed into a 12 qt bowl on an A-200 Hobart mixer.

b. The whole was mixed until uniform and water was added by separatory funnel while mixing continued.

c. Bars were then pressed on the Denison Hydraulic Press at 3 tons pressure and a dwell time of 1.5 sec.

d. The resulting bars were dried for 4 hrs in a forced air oven at 130°F.

e. The finished bars were then packed under air and nitrogen atmospheres in aluminized PVC pouches.

3. Results

a. Odor and flavor - acceptable in dry bars and in stew reconstituted at 40% solids.

b. Six foot drop test -good (broke in halves).

c. Stickiness (24 hrs at room temperature and 40% relative humidity) - none.

d. Mastication

Temp °F	35	70	100)
Shear	good	good	good	
Chew	good	good	good	
Swallow	good	good	good	

e. Dimensional Stability (24 hrs at 120°F 5 psi)

Before	17/32" x 2-1/32" x 4-1/32"
After	17/32" x 2-1/32" x 4-1/32"
Percent Change	None

f. Moisture 2.66

4. Storage Studies

a. <u>2 Weeks</u>	<u>Temp Air Pack</u>			<u>Nitrogen Pack</u>		
Temp °F	35	73	100	35	73	100
(1) Shear	Good	Good	Good	Good	Good	Good
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Stew	Good	Good	Good	Good	Good	Good
b. <u>4 Weeks</u>						
(1) Shear	Good	Good	Good	Good	Good	Good
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Stew	Good	Good	Good	Good	Good	Good
(5) Moisture		3.77	3.74			
c. <u>8 Weeks</u>						
(1) Shear	Good	Good	Good	Good	Good	Good
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Stew	Good	Good	Good	Good	Good	Good
d. <u>13 Weeks</u>						
(1) Shear	Good	Good	Good	Good	Good	Good
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Stew	Good	Good	Good	Good	Good	Good

13 Weeks - cont'd.	<u>Air Pack</u>			<u>Nitrogen Pack</u>		
Temp. °F	35	73	100	35	73	100
(5) Moisture		2.24	2.56			
(6) Bacteriology						
SPC		880	820			810
Coliforms		Neg.	Neg.			Neg.
Yeasts & Molds		< 10	10			< 10

C. Chili Con Carne with Beans Food Bar

1. Formula	%
Beans, Precooked, Freeze-dried (ref. Par. IV A, p. 13)	20.00
B ₂ Matrix	25.00
Onion Powder, Soluble	0.50
Beef, Precooked, Freeze Dried, 3/16" Grind, Wilson	25.00
Tomato Powder, I.D.I.T. S.p.A.	23.98
Sodium Bicarbonate	0.08
Chili Powder	2.50
Cumin	0.22
Salt, Flour	<u>2.00</u>
	100.00
Water per 100 gm Dry Ingredients	3 ml

2. Procedure

- a. All dry ingredients except meat and beans were weighed into the 12 qt bowl of the A-200 Hobart mixer and mixed until uniform.
- b. The water was added by separatory funnel while mixing continued.
- c. The meat and beans were then added and mixed briefly to avoid destroying particle identity.
- d. The resulting batch was pressed into bars on the Denison Hydraulic Press at 3 tons gauge pressure.

e. The finished bars were dried at 130°F for 4 hours in a forced air oven.

f. Under air and nitrogen atmosphere, the bars were packed in aluminized

PVC pouches.

3. Results

a. Odor and flavor - very good as dry bar and when reconstituted at 40%

solids as stew.

b. Six foot drop test - fair - 4 piece break (1/8, 1/8, 1/4, 1/2)

c. Stickiness (24 hours at room temperature and 40% relative humidity) -

none.

d. Mastication

Temp °F	35	73	100
Shear	Good	Good	Good
Chew	Good	Good	Good
Swallow	Good	Good	Good

e. Dimensional Stability (24 hrs at 120°F 5 psi)

Before	17/32" x 2-1/32" x 4"		
After	1/2 " x 2-1/32" x 4"		
Percent Change	-5.88	0	0

f. Moisture 3.95

4. Storage Studies

a. 2 Weeks

	<u>Air Pack</u>			<u>Nitrogen Pack</u>		
Temp (°F)	35	73	100	35	73	100
(1) Shear	Good	Good	Good	Good	Good	Good
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Stew	Good	Good	Good	Good	Good	Good

b. 4 Weeks

(1) Shear	Good	Good	Good	Good	Good	Good
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Stew	Good	Good	Good	Good	Good	Good

Storage Studies - cont'd.		<u>Air Pack</u>			<u>Nitrogen Pack</u>		
Temp (°F)		35	73	100	35	73	100
(5) Moisture			3.71	3.77			
c. <u>8 Weeks</u>							
(1) Shear	Good	Good	Good		Good	Good	Good
(2) Odor	Good	Good	Good		Good	Good	Good
(3) Flavor	Good	Good	Good		Good	Good	Good
(4) Stew	Good	Good	Good		Good	Good	Good
d. <u>13 Weeks</u>							
(1) Shear	Good	Good	Good		Good	Good	Good
(2) Odor	Good	Good	Good		Good	Good	Good
(3) Flavor	Good	Good	Good		Good	Good	Good
(4) Stew	Good	Good	Good		Good	Good	Good
(5) Moisture			3.41	3.92			
(6) Bacteriology							
SIC			490	530			520
Coliforms			Neg.	Neg.			Neg.
Yeasts & Molds			20	20			10

D. Shrimp Creole Food Bars

1. Formula	%
Shrimp, Precooked, Freeze-dried, Wilson	41.05
B ₂ Matrix	25.00
Onion Powder, Soluble	0.50
Tomato Powder, I.D.I.T. S.p.A.	14.00
Salt, Flour	2.00
Cayenne Pepper	0.05
Greer Bell Pepper, Dried, C.V.C.	4.40
Rice, Precooked, Freeze-dried (Ref. Par. IV B, p. 13)	<u>13.00</u>
	100.00
Water per 100 gm Dry Ingredients	5 ml

2. Procedure

- a. The shrimp were weighed into the 12 qt bowl of the A-200 Hobart mixer and shredded.
- b. The remainder of the dry ingredients were then added and the whole mixed until homogenous.
- c. Water was added by separatory funnel while mixing continued.
- d. The resulting 2.5 Kgm batch was pressed into bars on the Denison Hydraulic Press at 4.5 tons ram pressure and a dwell time of 2 sec.
- e. The finished bars were dried for 4 hrs at 130°F.
- f. The completed bars were sealed in aluminized PVC pouches under air and nitrogen atmospheres.

3. Results

- a. Odor and flour - excellent as dry bar and reconstituted at 40% solids in stew.
- b. Six foot drop test - excellent, broke into halves on 3rd drop
- c. Stickiness (24 hrs at room temperature and 40% relative humidity) - none.
- d. Mastication

Temp °F	35	70	100
Shear	good	good	good
Chew	good	good	good
Swallow	good	good	good

- e. Dimensional Stability (24 hrs at 120°F 5 psi)

Before	17/32" x 2-1/32" x 4-1/32"
After	17/32" x 2-1/32" x 4-1/32"
Percent Change	None

- f. Moisture 2.37%

4. Storage Studies

a. <u>2 Weeks</u>	<u>Air Pack</u>			<u>Nitrogen Pack</u>		
Temp (°F)	35	73	100	35	73	100
(1) Shear	Good	Good	Good	Good	Good	Good

Storage Studies - cont'd

<u>2 Weeks</u>		<u>Air Pack</u>			<u>Nitrogen Pack</u>		
Temp (°F)		35	73	100	35	73	100
(2) Odor		Good	Good	Good	Good	Good	Good
(3) Flavor		Good	Good	Good	Good	Good	Good
(4) Stew		Good	Good	Good	Good	Good	Good
b. <u>4 Weeks</u>							
(1) Shear		Good	Good	Good	Good	Good	Good
(2) Odor		Good	Good	Good	Good	Good	Good
(3) Flavor		Good	Good	Good	Good	Good	Good
(4) Stew		Good	Good	Good	Good	Good	Good
(5) Moisture			2.77	2.81			
c. <u>8 Weeks</u>							
(1) Shear		Good	Good	Good	Good	Good	Good
(2) Odor		Good	Good	Good	Good	Good	Good
(3) Flavor		Good	Good	Good	Good	Good	Good
(4) Stew		Good	Good	Good	Good	Good	Good
d. <u>13 Weeks</u>							
(1) Shear		Good	Good	Good	Good	Good	Good
(2) Odor		Good	Good	Wet card- board, off odor	Good	Good	Good
(3) Flavor		Good	Good	Good	Good	Good	Good
(4) Stew		Good	Good	Good	Good	Good	Good
(5) Moisture			3.16	3.00			
(6) Bacteriology							
SPC			800	120			120
Coliforms			Neg.	Neg.			Neg.
Molds & Yeasts			<10	100			100

E. Ground Beef with Rice Food Bars

1. Formula	%
B ₂ Matrix	15.0
Beef, Precooked, Freeze-dried, 3/16" Grind, Wilson	65.0
Rice, Precooked, Freeze-dried, (ref. par. IV B, p. 13)	16.5
Onion Powder, Soluble	1.0
Calery Salt	0.5
Pepper, Malabar, Ground	0.5
Salt, Flour	<u>1.5</u>
	100.0
Water per 100 gm Dry Ingredients	5 ml

2. Procedure

- a. All dry ingredients except rice and beef were mixed until homogeneous in the 12 qt bowl of the A-200 Hobart mixer.
- b. Water was added by separatory funnel while mixing continued.
- c. The rice and beef were then added and mixed briefly to preserve particle identity.
- d. Bars were pressed from the resulting 2.5 Kgm batch on the Denison Hydraulic Press at 5 tons ram pressure with a dwell time of 2-4 sec.
- e. The finished bars were dried for four hours at 130°F in a forced air oven.
- f. The dried bars were sealed into aluminized PVC pouches under air and nitrogen atmospheres.

3. Results

- a. Odor and flavor - acceptable as a dry bar and as a stew reconstituted at 40% solids.
- b. Six foot drop test - fair, broke in 3 pieces - 1/4, 1/4, 1/2.
- c. Stickiness (24 hours at room temperature and 40% relative humidity) - none.

d. Mastication

Temp (°F)	35	73	100
Shear	Good	Good	Good
Chew	Good	Good	Good
Swallow	Good	Good	Good

e. Dimensional Stability (24 hours at 120°F 5 psi)

Before	1/2" x 2-1/32" x 4-1/32"		
After	15/32" x 2-1/32" x 4"		
Percent Change	-6.25	0	-0.77

f. Moisture 7.17

4. Storage Studies

a. 2 Weeks

Temp (°F)	<u>Air Pack</u>			<u>Nitrogen Pack</u>		
	35	73	100	35	73	100
(1) Shear	Good	Good	Good	Good	Good	Good
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Stew	Good	Good	Good	Good	Good	Good

b. 4 Weeks

(1) Shear	Good	Good	Good	Good	Good	Good
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Stew	Good	Good	Good	Good	Good	Good
(5) Moisture		3.47	3.03			

c. 8 Weeks

(1) Shear	Good	Good	Good	Good	Good	Good
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Stew	Good	Good	Good	Good	Good	Good

Storage Studies - cont'd.

d. 13 Weeks	<u>Air Pack</u>			<u>Nitrogen Pack</u>		
Temp (°F)	35	73	100	35	73	100
(1) Shear	Good	Good	Good	Good	Good	Good
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Stew	Good	Good	Good	Good	Good	Good
(5) Moisture		3.15	3.10			
(6) Bacteriology						
SPC		> 3000	3000			> 3000
Coliforms		Neg.	Neg.			Neg.
Molds & Yeasts		360	500			400

F. Creamed Ground Beef Food Bar

1. Formula	%
B ₂ Matrix	44.00
Beef, Precooked, Freeze-dried, 3/16" Grind, Wilson	41.00
Dextrinized Starch	10.82
Salt, Flour	3.00
Monosodium Glutamate	1.00
Pepper, Ground, Malabar	<u>0.18</u>
	100.00
Water per 100 gm Dry Ingredients	3 ml

2. Procedure

- a. All dry ingredients were weighed into the 12 qt bowl of the A-200 Hobart mixer and mixed until homogenous.
- b. Water was added by separatory funnel while mixing continued.
- c. The resulting 1600 gm batch was pressed into bars on the Denison Hydraulic Press at 3 tons ram pressure with a dwell time of 1.5 sec.

- d. The finished bars were dried at 130°F for 4 hours in a forced air oven.
- e. The dried bars were packed under air and nitrogen atmospheres in aluminized PVC pouches.

3. Results

- a. Odor and flavor - acceptable as the dry bar and when reconstituted as a stew at 40% solids.
- b. Six foot drop test - excellent - broke into 1/2 and fragments on 2nd drop
- c. Stickiness (24 hours at room temperature and 40% relative humidity) - none.
- d. Mastication

Temp (°F)	35	70	100
Shear	Good	Good	Good
Chew	Good	Good	Good
Swallow	Good	Good	Good

- e. Dimensional Stability (24 hours at 120°F 5 psi)

Before	1/2" x 2-1/32" x 4-1/32"
After	1/2" x 2-1/32" x 4-1/32"
Percent Change	None

- f. Moisture 2.75%

4. Storage Studies

a. 2 Weeks

Temp (°F)	<u>Air Pack</u>			<u>Nitrogen Pack</u>		
	35	73	100	35	73	100
(1) Shear	Good	Good	Good	Good	Good	Good
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Stew	Good	Good	Good	Good	Good	Good

b. 4 Weeks

(1) Shear	Good	Good	Good	Good	Good	Good
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Stew	Good	Good	Good	Good	Good	Good
(5) Moisture		3.11	3.21			

Storage Studies - cont'd.

c.	<u>8 Weeks</u>	<u>Air Pack</u>			<u>Nitrogen Pack</u>		
	Temp (°F)	35	73	100	35	73	100
	(1) Shear	Good	Good	Good	Good	Good	Good
	(2) Odor	Good	Good	Good	Good	Good	Good
	(3) Flavor	Good	Good	Good	Good	Good	Good
	(4) Stew	Good	Good	Good	Good	Good	Good
d.	<u>13 Weeks</u>						
	(1) Shear	Good	Good	Good	Good	Good	Good
	(2) Odor	Good	Good	Good	Good	Good	Good
	(3) Flavor	Good	Good	Good	Good	Good	Good
	(4) Stew	Good	Good	Good	Good	Good	Good
	(5) Moisture		3.15	3.10			
	(6) Bacteriology						
	SPC		> 3000	2400			2300
	Coliforms		Neg.	Neg.			Neg.
	Yeasts & Molds		150	210			200

G. Chicken a la King Food Bar

1. Formula	%
Chicken, Precooked, Freeze-dried, 1/4" dices, Wilson	50.00
Morel Powder, S.P.I.	1.00
Mushrooms, 1/4" Dice	5.50
Pimientos, Freeze-dried (ref. Par IV E, p. 14)	3.00
B ₂ Matrix	27.50
Pregelatinized Waxy Maize Starch	8.00
Salt	<u>5.00</u>
	100.00
Water per 100 gm Dry Ingredients	5 ml

2. Procedure

- a. All dry ingredients were mixed until homogenous in the A-200 Hobart mixer in the 12 qt bowl.
- b. The water was then added by separatory funnel while mixing continued.
- c. The resulting 2.5 Kgm batch was pressed into bars on the Denison Press at 3 ton ram pressure and a dwell time of 2 sec.
- d. Finished bars were dried at 130°F for 4 hours.
- e. The dry bars were packed into aluminized PVC pouches under nitrogen and air atmosphere.

3. Results

- a. Odor and flavor - good as dry bar and as stew when reconstituted at 30% solids.
- b. Six foot drop test - excellent, broke into 1/2, 1/4 and 1/4 on 2nd drop.
- c. Stickiness (24 hours at room temperature and 40% relative humidity) - none.
- d. Mastication

Temp (°F)	35	70	100
Shear	Good	Good	Good
Chew	Good	Good	Good
Swallow	Good	Good	Good

- e. Dimensional Stability (24 hours at 120°F 5 psi)

Before	17/32" x 2-1/32" x 4-1/32"
After	1/2" x 2-1/32" x 4-1/32"
Percent Change	-5.88 0 0

- f. Moisture 3.35

4. Storage Studies

a. 2 Weeks

Temp (°F)	<u>Air Pack</u>			<u>Nitrogen Pack</u>		
	35	73	100	35	73	100
(1) Shear	Good	Good	Good	Good	Good	Good
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Stew	Good	Good	Good	Good	Good	Good

Storage Studies - cont'd.

b. 4 Weeks

Temp (°F)	<u>Air Pack</u>			<u>Nitrogen Pack</u>		
	35	73	100	35	73	100
(1) Shear	Good	Good	Good	Good	Good	Good
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Stew	Good	Good	Good	Good	Good	Good
(5) Moisture		3.23	3.18			

c. 8 Weeks

(1) Shear	Good	Good	Good	Good	Good	Good
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Stew	Good	Good	Good	Good	Good	Good

d. 13 Weeks

(1) Shear	Good	Good	Good	Good	Good	Good
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Stew	Good	Good	Good	Good	Good	Good
(5) Moisture		3.19	3.00			
(6) Bacteriology						
SPC		> 3000	2000			1900
Coliforms		Neg.	Neg.			Neg.
Yeasts & Molds		< 10	< 10			< 10

H. Cream of Mushroom Soup Food Bars

1. Formula	%
B ₂ Matrix	50.00
Non-Fat Dry Milk Solids, Maple Island, Instant	25.00
Mushrooms, 1/4" Dice	10.00
Salt, Flour	5.00

Formula - cont'd.	%
Pregelatinized Waxy Maize Starch	5.00
Morel Powder S.P.I.	2.50
Onion Powder, Soluble	7.00
Monosodium Glutamate	<u>0.50</u>
	100.00
Water per 100 gm Dry Ingredients	3 ml

2. Procedure

- All dry ingredients were mixed until homogenous in the 12 qt bowl of the A-200 Hobart mixer, the water was then added by separatory funnel while mixing continued.
- From the resulting 1.6 Kgm batch, bars were formed on the Denison Hydraulic Press at 2-2/3 tons pressure on the ram at a dwell time of 15-20% of 10 sec.
- The finished bars were dried in the forced air oven for four hours at 130°F.
- The dried bars were packed in aluminized PVC pouches under nitrogen and under air atmospheres.

3. Results

- Odor and flavor - good as dry bar and as soup reconstituted at 20% solids.
- Six foot drop test - fair for pieces about 1/4 of bar each.
- Stickiness (24 hours at room temperature and 40% relative humidity) - none.
- Mastication

Temp (°F)	35	70	100
Shear	Good	Good	Good
Chew	Good	Good	Good
Swallow	Good	Good	Good

- Dimensional Stability (24 hours at 120°F 5 psi)

Before	17/32" x 2-1/32" x 4-1/32"
After	17/32" x 2-1/32" x 4-1/32"
Percent Change	None

- Moisture 5.51%

4. Storage Studies

a. <u>2 Weeks</u>		<u>Air Pack</u>			<u>Nitrogen Pack</u>		
Temp (°F).		35	73	100	35	73	100
(1) Shear		Good	Good	Good	Good	Good	Good
(2) Odor		Good	Good	Good	Good	Good	Good
(3) Flavor		Good	Good	Good	Good	Good	Good
(4) Soup		Good	Good	Good	Good	Good	Good
b. <u>4 Weeks</u>							
(1) Shear		Good	Good	Good	Good	Good	Good
(2) Odor		Good	Good	Good	Good	Good	Good
(3) Flavor		Good	Good	Good	Good	Good	Good
(4) Soup		Good	Good	Good	Good	Good	Good
(5) Moisture			2.75	2.53			
c. <u>8 Weeks</u>							
(1) Shear		Good	Good	Good	Good	Good	Good
(2) Odor		Good	Good	Good	Good	Good	Good
(3) Flavor		Good	Good	Good	Good	Good	Good
(4) Soup		Good	Good	Good	Good	Good	Good
d. <u>13 Weeks</u>							
(1) Shear		Good	Good	Good	Good	Good	Good
(2) Odor		Good	Good	Good	Good	Good	Good
(3) Flavor		Good	Good	Good	Good	Good	Good
(4) Soup		Good	Good	Good	Good	Good	Good
(5) Moisture			2.92	2.51			
(6) Bacteriology							
SPC			2000	1800			1480
Coliforms			Neg.	Neg.			Neg.
Yeasts & Molds			20	20			20

1. Cream of Tomato Soup Food Bars

1. Formula	%
A ₃ Matrix	50.00
Tomato Powder, I.D.I.T. S.p.A.	25.00
Non-Fat Dry Milk, Maple Island Instant	10.00
Pregelatinized Waxy Maize Starch	10.97
Salt, Flour	4.00
Cayenne Pepper	<u>0.03</u>
	100.00
Water per 100 gm Dry Ingredients	2 ml

2. Procedure

- All dry materials were mixed until homogenous in a one cubic foot Patterson-Kelley twin cone blender with intensifier bar.
- The water was added through the intensifier bar during mixing.
- The resulting 1.6 Kgm batch was pressed into bars on the Denison Hydraulic Press at 2-2/3 ton ram pressure and dwell time of 10-25% of 10 sec.
- The finished bars were dried for 4 hours at 130°C in a forced air oven.
- The dried bars were sealed in alumnized PVC pouches under nitrogen and air atmosphere.

3. Results

- Odor and flavor - good as dry bar and as soup reconstituted at 15% solids.
- Six foot drop test - fair, broke into eight, approximately equal, pieces.
- Stickiness (24 hours at room temperature and 40% relative humidity) - none.
- Mastication

Temp (°F)	35	70	100
Shear	Good	Good	Good
Chew	Good	Good	Good
Swallow	Good	Good	Good

- Dimensional Stability (24 hours at 120°F 5 psi)

Before	17/32"	x 2-1/32"	x 4-1/32"
After	1/2"	x 2	x 4
Percent Change	-5.88	-1.53	-0.77

4. Storage Studies

a.	<u>2 Weeks</u>	<u>Air Pack</u>			<u>Nitrogen Pack</u>		
	Temp (°F)	35	73	100	35	73	100
	(1) Shear	Good	Good	Good	Good	Good	Good
	(2) Odor	Good	Good	Good	Good	Good	Good
	(3) Flavor	Good	Good	Good	Good	Good	Good
	(4) Soup	Good	Good	Good	Good	Good	Good
b.	<u>4 Weeks</u>						
	(1) Shear	Good	Good	Good	Good	Good	Good
	(2) Odor	Good	Good	Good	Good	Good	Good
	(3) Flavor	Good	Good	Good	Good	Good	Good
	(4) Soup	Good	Good	Good	Good	Good	Good
	(5) Moisture		4.24	4.30			
c.	<u>8 Weeks</u>						
	(1) Shear	Good	Good	Good	Good	Good	Good
	(2) Odor	Good	Good	Good	Good	Good	Good
	(3) Flavor	Good	Good	Good	Good	Good	Good
	(4) Soup	Good	Good	Good	Good	Good	Good
d.	<u>13 Weeks</u>						
	(1) Shear	Good	Good	Good	Good	Good	Good
	(2) Odor	Good	Good	Good	Good	Good	Good
	(3) Flavor	Good	Good	Good	Good	Good	Good
	(4) Soup	Good	Good	Good	Good	Good	Good
	(5) Moisture		4.10	4.46			
	(6) Bacteriology						
	SPC		1090	520			490
	Coliforms		Neg.	>10			> 10
	Yeasts & Molds		10	>0			> 0

J. Lemon Pie Filling Food Bar

1. Formula	%
A ₃ Matrix	50.00
Sucrose, 6X	24.45
Non-Fat Dry Milk Solids, Maple Island, Instant	20.00
Starch	5.00
Lemon Flavor, Florasynth	0.45
Keltose S.G.	<u>0.10</u>
	100.00

Water (containing 0.07 ml. 4% FD&C Yellow No. 6/100 ml.) 2 ml. per 100 g. dry ingredients.

2. Procedure

- a. The matrix was weighed into the one cubic foot Patterson Kelly twin cone blendor with intensifier bar.
- b. The water was added through the intensifier bar while mixing continued.
- c. The remainder of the ingredients was then added and the whole mixed until homogeneous.
- d. Bars were formed from the resulting 1.6 Kgm batch on the Denison Hydraulic Press at 2.75 tons ram pressure and a dwell time of 50% of 1 second.
- e. The finished bars were packed without drying in aluminized PVC pouches under air and nitrogen atmospheres.

3. Results

- a. Odor and flavor - good as dry bars and when reconstituted at 30% solids for pie filling.
- b. Six-foot drop test - fair, broke into eight pieces.
- c. Stickiness (24 hours at room temperature and 40% relative humidity) none.
- d. Mastication

Temp. (°F)	35	70	100
Shear	Good	Good	Good
Chew	Good	Good	Good
Swallow	Good	Good	Good

e. Dimensional Stability (24 hours @ 120° F 5 psi)

Before	17/32" x 2-1/32" x 4-1/32"
After	17/32" x 2-1/32" x 4-1/32"
Percent Change	None

f. Moisture 5.40%

4. Storage Studies

a. 2 Weeks

	<u>Air Pack</u>			<u>Nitrogen Pack</u>		
Temp (°F)	35	73	100	35	73	100
(1) Shear	Good	Good	Good	Good	Good	Good
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Pudding	Good	Good	Good	Good	Good	Good

b. 4 Weeks

(1) Shear	Good	Good	Good	Good	Good	Good
(2) Odor	Good	Good	Scorched Milk	Good	Good	Scorched Milk
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Pudding	Good	Good	Good	Good	Good	Good
(5) Moisture		4.96	4.95			

c. 8 Weeks

(1) Shear	Good	Good	Good	Good	Good	Good
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Pudding	Good	Good	Good	Good	Good	Good

d. 13 Weeks

(1) Shear	Good	Good	Good	Good	Good	Good
(2) Odor	Good	Sl. Burned	Sl. Burned	Good	Sl. Burned	Sl. Burned
(3) Flavor	Good	Sl. Burned	Sl. Burned	Good	Sl. Burned	Sl. Burned
(4) Pudding	Good	Sl. Burned	Sl. Burned	Good	Sl. Burned	Sl. Burned

d. 13 Weeks - Cont'd.	<u>Air Pack</u>			<u>Nitrogen Pack</u>		
Temp (°F)	35	73	100	35	73	100
(5) Moisture		4.93	5.22			
(6) Bacteriology						
SPC		1460	1900			1800
Coliforms	<10>1.0	Neg.				Neg.
Yeasts & Molds	180	<10				< 10

K. Barley Soup with Beef Food Bar

1. Formula	%
Barley, Freeze-dried, Precooked (ref. Para. IV C, p. 13)	48.00
Bouillon, Maggi	20.00
B ₂ Matrix	17.00
Beef, Precooked, Freeze-dried, Wilson	13.75
Pepper, Malabar, Ground	0.25
Celery Seed	0.25
Parsley, Dried, C.V.C.	0.25
Monosodium Glutamate	<u>0.50</u>
	100.00
Water per 100 gm Dry Ingredients	5 ml

2. Procedure

a. The beef was weighed into the 12 qt bowl of the A-200 Hobart mixer and broken up into shreds.

b. The remainder of the dry ingredients was then added and the whole mixed until homogeneous.

c. Water was added by separatory funnel while mixing continued.

d. The resulting 2.5 Kgm batch was pressed into bars on the Denison Hydraulic Press at 5 tons ram pressure and a dwell time of 1 sec.

e. The finished bars were dried for four hours at 130°F.

f. The dried bars were sealed into aluminized PVC pouches under nitrogen and air atmospheres.

3. Results

a. Odor and flavor - good as dry bar and as soup reconstituted at 15% solids.

b. Six foot drop test - excellent - broke in half on second drop.

c. Stickiness (24 hours at room temperature and 40% relative humidity)

- none.

d. Mastication

Temp (°F)	35	70	100
Shear	Good	Good	Good
Chew	Good	Good	Good
Swallow	Good	Good	Good

e. Dimensional Stability (24 hours at 120°F 5 psi)

Before	17/32" x 2-1/32" x 4-1/32"		
After	1/2" x 2-1/32" x 4-1/32"		
Percent Change	-5.88	0	0

f. Moisture 3.64

4. Storage Studies

a. 2 Weeks

Temp (°F)	<u>Air Pack</u>			<u>Nitrogen Pack</u>		
	35	73	100	35	73	100
(1) Shear	Good	Good	Good	Good	Good	Good
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Soup	Good	Good	Good	Good	Good	Good

b. 4 Weeks

(1) Shear	Good	Good	Good	Good	Good	Good
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Soup	Good	Good	Good	Good	Good	Good
(5) Moisture		3.74	3.42			

Storage Studies - cont'd.

c. <u>8 Weeks</u>		<u>Air Pack</u>			<u>Nitrogen Pack</u>		
Temp (°F)		35	73	100	35	73	100
(1) Shear		Good	Good	Good	Good	Good	Good
(2) Odor		Good	Good	Good	Good	Good	Good
(3) Flavor		Good	Good	Good	Good	Good	Good
(4) Soup		Good	Good	Good	Good	Good	Good
d. <u>13 Weeks</u>							
(1) Shear		Good	Good	Good	Good	Good	Good
(2) Odor		Good	Good	Good	Good	Good	Good
(3) Flavor		Good	Good	Good	Good	Good	Good
(4) Soup		Good	Good	Good	Good	Good	Good
(5) Moisture			3.43	3.47			
(6) Bacteriology							
	SPC		>3000	>3000			>3000
	Coliforms		Neg.	Neg.			Neg.
	Yeasts & Molds		220	220			210

L. Shrimp Bisque Food Bar

1. Formula	%
Shrimp, Freeze-dried, Wilson	53.00
B ₂ Matrix	25.00
Non-Fat Dry Milk Solids, Maple Island, Instant	18.95
Onion Powder, Soluble	0.50
Salt, Flour	2.00
Pepper, White, Ground	0.25
Nutmeg, Ground	0.10
Parsley, Dried, C.V.C.	<u>0.20</u>
	100.00
Water per 100 gm Dry Ingredients	5 ml

2. Procedure

- a. The shrimp was weighed into the 12 qt bowl of the A-200 Hobart mixer and shredded.
- b. The balance of the dry ingredients was then added and the whole mixed until homogeneous.
- c. The water was then added, while mixing continued, by separatory funnel.
- d. Bars from the resulting 2.5 Kgm batch were pressed on the Denison Hydraulic Press at 5 tons ram pressure and a dwell time of 1 sec.
- e. The finished bars were dried 3 hours at 130°F.
- f. The dry bars were sealed into ~~aluminized~~ PVC pouches.

3. Results

- a. Odor and flavor - excellent as dry bar and as a soup when reconstituted at 25% solids.
- b. Six foot drop test - excellent - broke in half on fourth drop.
- c. Stickiness (24 hours at room temperature and 40% relative humidity) - none.

d. Mastication

Temp (°F)	35	70	100
Shear	Good	Good	Good
Chew	Good	Good	Good
Swallow	Good	Good	Good

e. Dimensional Stability (24 hours at 120°F 5 psi)

Before	1/2" x 2-1/32" x 4-1/32"
After	1/2" x 2-1/32" x 4-1/32"
Percent Change	None

f. Moisture 3.10%

4. Storage Studies

a. 2 Weeks

	<u>Air Pack</u>			<u>Nitrogen Pack</u>		
Temp (°F)	35	73	100	35	73	100
(1) Shear	Good	Good	Good	Good	Good	Good

Storage Studies - cont'd.

<u>2 Weeks</u>		<u>Air Pack</u>			<u>Nitrogen Pack</u>		
Temp (°F)		35	73	100	35	73	100
(2) Odor		Good	Good	Good	Good	Good	Good
(3) Flavor		Good	Good	Good	Good	Good	Good
(4) Soup		Good	Good	Good	Good	Good	Good
b. <u>4 Weeks</u>							
(1) Shear		Good	Good	Good	Good	Good	Good
(2) Odor		Good	Good	Good	Good	Good	Good
(3) Flavor		Good	Good	Good	Good	Good	Good
(4) Soup		Good	Good	Good	Good	Good	Good
(5) Moisture			2.97	2.96			
c. <u>8 Weeks</u>							
(1) Shear		Good	Good	Good	Good	Good	Good
(2) Odor		Good	Good	Good	Good	Good	Good
(3) Flavor		Good	Good	Good	Good	Good	Good
(4) Soup		Good	Good	Good	Good	Good	Good
d. <u>13 Weeks</u>							
(1) Shear		Good	Good	Good	Good	Good	Good
(2) Odor		Good	Good	Good	Good	Good	Good
(3) Flavor		Good	Good	Good	Good	Good	Good
(4) Soup		Good	Good	Good	Good	Good	Good
(5) Moisture			3.11	3.10			
(6) Bacteriology							
	SPC		680	840			830
	Coliforms		Neg.	Neg.			Neg.
	Yeasts & Molds		20	120			100

M. Coffee with Cream and Sugar Food Bars

1. Formula	%
Sucrose, granulated	45.1

A ₃ Matrix	22.5
Non-Fat Dry Milk Solids, Maple Island, Instant	13.5
Coffee, Instant, Maxwell House	12.0
Corn Syrup Solids	6.0
Falcofix, Felton Chemical Co.	<u>0.9</u>
	100.0
Water (containing 4% Dibasic Potassium Phosphate)per 100 gm Dry Ingredients	3 ml

2. Procedure

- a. All dry ingredients were weighed into a one cubic foot Patterson Kelly twin cone blender and mixed until homogeneous.
- b. The water was added through the intensifier bar while mixing continued.
- c. The resulting 2.5 Kgm batch was pressed into bars on the Denison Hydraulic Press at 3 tons ram pressure and a dwell time of 60% of 1 sec.
- d. The bars were not dried, but sealed into aluminized PVC pouches under air and nitrogen atmospheres.

3. Results

- a. Odor and flavor - good as dry bars and when reconstituted at 4.3% solids as a beverage.
- b. Six foot drop test - fair, broke into 5 pieces.
- c. Stickiness (24 hours at room temperature and 40% relative humidity) - none.

d. Mastication

Temp (°F)	35	70	100	1
Shear	Good	Good	Good	
Chew	Good	Good	Good	
Swallow	Good	Good	Good	

e. Dimensional Stability (24 hours at 120°F 5 psi)

Before	1/2" x 2-1/32" x 4-1/32"	1
After	1/2" x 2-1/32" x 4-1/32"	
Percent Change	None	

f. Moisture 4.71

4. Storage Studies

a. 2 Weeks

Temp (°F)	<u>Air Pack</u>			<u>Nitrogen Pack</u>		
	35	73	100	35	73	100
(1) Shear	Good	Good	Good	Good	Good	Good
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Drink	Good	Good	Good	Good	Good	Good

b. 4 Weeks

(1) Shear	Good	Good	Diffi- cult	Good	Good	Diffi- cult
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Drink	Good	Good	Good	Good	Good	Good
(5) Moisture		4.47	4.39			

c. 8 Weeks

(1) Shear	Good	Good	Diffi- cult	Good	Good	Diffi- cult
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Sl. bitter	Good	Good	Sl. bitter
(4) Drink	Good	Good	Sl. bitter	Good	Good	Sl. bitter

d. 13 Weeks

(1) Shear	Sl. Diffi- cult	Sl. Diffi- cult	Diffi- cult	Sl. Diffi- cult	Sl. Diffi- cult	Diffi- cult
(2) Odor	Good	Good	Sl. burned	Good	Good	Sl. Burned
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Drink	Good	Good	Good	Good	Good	Good

13 Weeks - cont'd.	<u>Air Pack</u>			<u>Nitrogen Pack</u>		
Temp (°F)	35	73	100	35	73	100
(5) Moisture		4.42	4.42			
(6) Bacteriology						
SPC		340	270			280
Coliforms		Neg.	Neg.			Neg.
Yeasts & Molds		< 10	< 10			< 10

N. Tomato Juice Cocktail Food Bars

1. Formula	%
Tomato Powder, I.D.I.T. S.p.A.	67.95
Solu-Pro, Wilson	25.00
Salt, Flour	5.00
Celery Salt	2.00
Cayenne Pepper, Ground	<u>0.05</u>
	100.00
Water per 100 gm Dry Ingredients	1 ml

2. Procedure

a. All dry ingredients were weighed into the one cubic foot Patterson

Kelly twin cone blender with intensifier bar and mixed until homogeneous.

b. The water was added through the intensifier bar while mixing continued.

c. The resulting 2.5 Kgm batch was pressed into bars on the Denison

Hydraulic Press at 2.5 tons ram pressure and a dwell time of 20% of 10 sec.

d. The finished bars were packed without drying into aluminized FVC pouches.

3. Results

a. Odor and flavor - good as dry bar and as beverage reconstituted at 10%

solids.

b. Six foot drop test - fair, broke into 8 pieces.

c. Stickiness (24 hours at room temperature and 40% relative humidity) -

none.

d. Mastication

Temp (°F)	35	70	100
Shear	Good	Good	Good
Chew	Good	Good	Good
Swallow	Good	Good	Good

e. Dimensional Stability (24 hours at 120°F 5 psi)

Before	17/32" x 2-1/32" x 4-1/32"		
After	1/2" x 2"	x 4-1/32"	
Percent Change	-5.88	-1.53	0

f. Moisture 8.66

4. Storage Studies

a. 2 Weeks

Temp (°F)	<u>Air Pack</u>			<u>Nitrogen Pack</u>		
	35	73	100	35	73	100
(1) Shear	Good	Good	Good	Good	Good	Good
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Drink	Good	Good	Good	Good	Good	Good

b. 4 Weeks

(1) Shear	Good	Good	Good	Good	Good	Good
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Drink	Good	Good	Good	Good	Good	Good
(5) Moisture		7.76	8.46			

c. 8 Weeks

(1) Shear	Good	Good	Good	Good	Good	Good
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Drink	Good	Good	Good	Good	Good	Good

G.	13 Weeks	Air Pack			Nitrogen Pack		
	Temp (°F)	35	73	100	35	73	100
(1)	Shear	Sl. Diffi-cult	Sl. Diffi-cult	Diffi-cult	Sl. Diffi-cult	Sl. Diffi-cult	Diffi-
(2)	Odor	Good	Good	Good	Good	Good	Good
(3)	Flavor	Good	Good	Bitter	Good	Good	bitter
(4)	Drink	Good	Good	Bitter	Good	Good	Bitter
(5)	Moisture		7.17	8.04			
(6)	Bacteriology						
	SPC		> 3000	2350			2300
	Coliforms		Neg.	Neg.			Neg.
	Yeasts & Molds		30	40			30

O. Orange Juice Food Bar

1. Formula	%
Orange Juice Powder, Calif. Citrus Growers	38.00
Corn Syrup Solids	32.00
Sucrose	20.00
Solu-Pro, Wilson	<u>10.00</u>
	100.00
Water per 100 gm Dry Ingredients	3 ml

2. Procedure

a. All dry ingredients were weighed into the one cubic foot Patterson

Kelly twin cone blender with intensifier bar and mixed until homogeneous.

b. The water was added through the intensifier bar while mixing continued.

c. The resulting 2.5 Kg_m batch was pressed into bars on the Denison

Hydraulic Press with a dwell time of 35% of 10 sec. at 3 tons ram pressure.

d. The finished bars were not dried, but packed in aluminized PVC pouches under air and nitrogen atmospheres.

3. Results

a. Odor and flavor - good as dry bar and as beverage reconstituted at

22% solids.

b. Six foot drop test - fair, broke into six pieces.

c. Stickiness (24 hours at room temperature and 40% relative humidity) - none.

d. Mastication

Temp (°F)	35	70	100
Shear	Good	Good	Good
Chew	Good	Good	Good
Swallow	Good	Good	Good

e. Dimensional Stability (24 hours at 120°F 5 psi)

Before 17/32" x 2-1/32" x 4-1/32"

After 17/32" x 2-1/32" x 4-1/32"

Percent Change None

f. Moisture 4.91

4. Storage Studies

a. 2 Weeks

Temp (°F)	<u>Air Pack</u>			<u>Nitrogen Pack</u>		
	35	73	100	35	73	100
(1) Shear	Good	Good	Good	Good	Good	Good
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Drink	Good	Good	Good	Good	Good	Good

b. 4 Weeks

(1) Shear	Good	Good	Good	Good	Good	Good
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Drink	Good	Good	Good	Good	Good	Good
(5) Moisture		4.87	4.86			

c. 8 Weeks

(1) Shear	Good	Good	Good	Good	Good	Good
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Drink	Good	Good	Good	Good	Good	Good

Storage Studies - cont'd.

d. 13 Weeks

Temp (°F)	<u>Air Pack</u>			<u>Nitrogen Pack</u>		
	35	73	100	35	73	100
(1) Shear	Good	Good	Sl. Difficult	Good	Good	Good
(2) Odor	Good	Good	Good	Good	Good	Good
(3) Flavor	Good	Good	Good	Good	Good	Good
(4) Drink	Good	Good	Good	Good	Good	Good
(5) Moisture		4.86	5.04			
(6) Bacteriology						
SPC		60	30			20
Coliforms		Neg.	Neg.			Neg.
Yeasts & Molds		< 10	< 10			< 10

CONCLUSIONS

In the sense and meaning of paragraph 1 of the Scope of the Contract, this contract has been fulfilled. The matrices developed and discovered have successfully been used in the fabrication of food bars from nearly any food having reasonable physical stability. The chemical and microbiological instability of certain of these foods, notably the peanut and sweet chocolate food bars were previously well known and were again demonstrated during these storage studies. In no case could any objectionable flavors or odors be assigned to the matrices.

PROPOSALS FOR FUTURE RESEARCH

Some of our related exploratory work indicates that these matrices, when used as coatings, can protect foods against oxidation and some microbiological deterioration. These coatings are much the same in formula as the matrices but the water level is raised to about 60% giving it the consistency of molasses. The foods are dipped into this coating and the resulting "bit" is dried to a 4-6% moisture level. It is conceivable that food particles could be individually coated, then the coated particles compressed into food bars, thus completely coating the food and providing an oxygen barrier. This would extend the organoleptic and microbiological stability of the food material.

PRODUCTION DESIGN FOR 6,000 FOOD BARS PER HOUR

<u>Operation</u>	<u>Equipment Required</u>
Weighting	Ingredient storage bins. 30 cu ft scale hopper, 200# scale levers and dial
Mixing	30 cu ft Ribbon blender - Strong Scott IN 30 or equal with liquid manifold and spray nozzles. P.K. Blendor with intensifier bar or equal
Transfer	Gravity spouts, food grade belt or stainless steel flight conveyor
Surge hoppers	One 30 cu ft hopper
Hydraulic Press	45 ton force, 6½ second cycle to 1 feed in 2 compress 3 eject 12 units per die, each unit 2" x 4" with 4¼ deep cavity compress to 2" x 4" by 1/2" thick Denison Multipress with automatic feed (or equal)
Packaging	Seal in metalized polyethylene polyester pouches. Modify Barfelt Model IM6 to handle food bars. Nitrogen metering and pouch vacuumizing accessories required.
Spray Drying	200#/hr weight capacity (dry)

PRODUCTION UNIT

The basis for design is as follows:

Production rate	6,600 food bars per hour
Allowance for breakage	6%
Weight of formula mix	1,140#/hr maximum 710#/hr minimum
Volume of total formula mix per hour	117 cu ft

Volume of formula mix $2" \times 4" \times 4\frac{1}{2}" = 34 \text{ cu in}$
per unit

Volume of compressed $2" \times 4" \times \frac{1}{2}" = 4 \text{ cu in}$
food bar per unit

Number of scale batches 6 per hour

Scaling & mixing cycle
time 10 minutes

Mix time 6 minutes

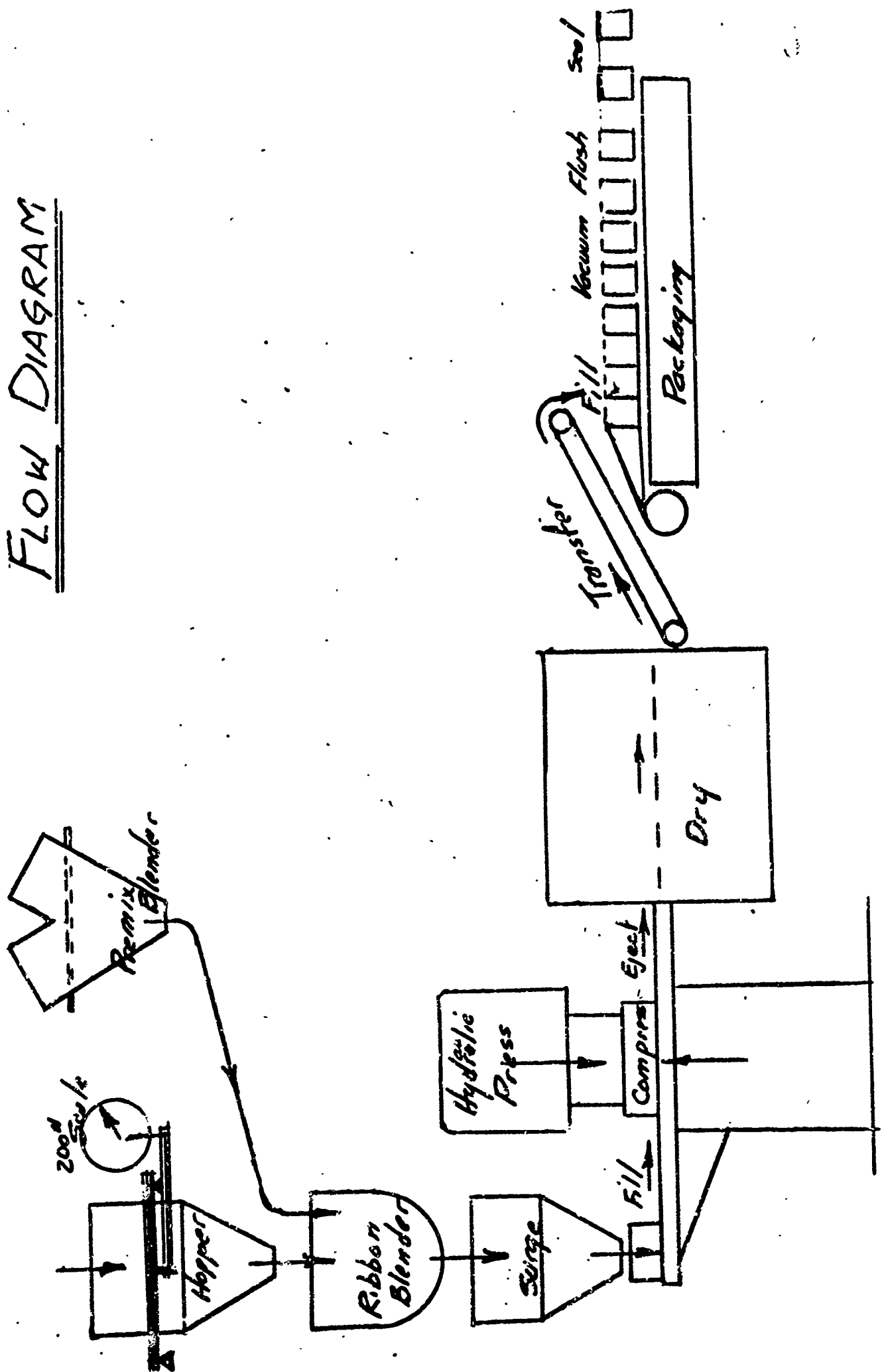
DESCRIPTION OF PROCESS

Ingredients will be scaled into weigh nopper and cycled into batch ribbon blender. P.K. blender will be used to premix small volume ingredients prior to adding to ribbon blender.

Ribbon blender is discharged into surge hopper feeding the filler unit of the hydraulic press. The filler unit fills the cavities of the hydraulic press; pressure is then applied to compress the mix into $1/2"$ thick bars. Pressure required to form bars varies from 375 psi minimum to 900 psi maximum.

The compressed bar is ejected into a continuous drying oven, heated to a temperature of 140° , and retained for 20 minutes. The dried bars are then conveyed to the packaging area where they are placed in a pouch, nitrogen flushed when required, and vacuum sealed.

FLOW DIAGRAM



Unclassified

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10. AVAILABILITY/LIMITATION NOTICES		
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		Animal Products Branch, Food Division U. S. Army Natick Laboratories, Natick, Massachusetts, 01762
13. ABSTRACT		
<p>Edible binders have been developed which impart favorable physical properties including cohesiveness to compressed dry foods representing a broad range of chemical compositions. Further experimental effort yielded binders for compressed foods which are acceptable for consumption from the compressed state and which can also be rehydrated to yield a familiar meal item, such as casseroles, creamed soups, puddings, thin soups and beverages. These binders do not significantly alter the storage stability of the basic food components.</p>		

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Development	8					
Preparation (formulation)	8					
Matrices (food)	9		9			
Food bars	4		9			
Military rations	4		4			
Storage stability			8			

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